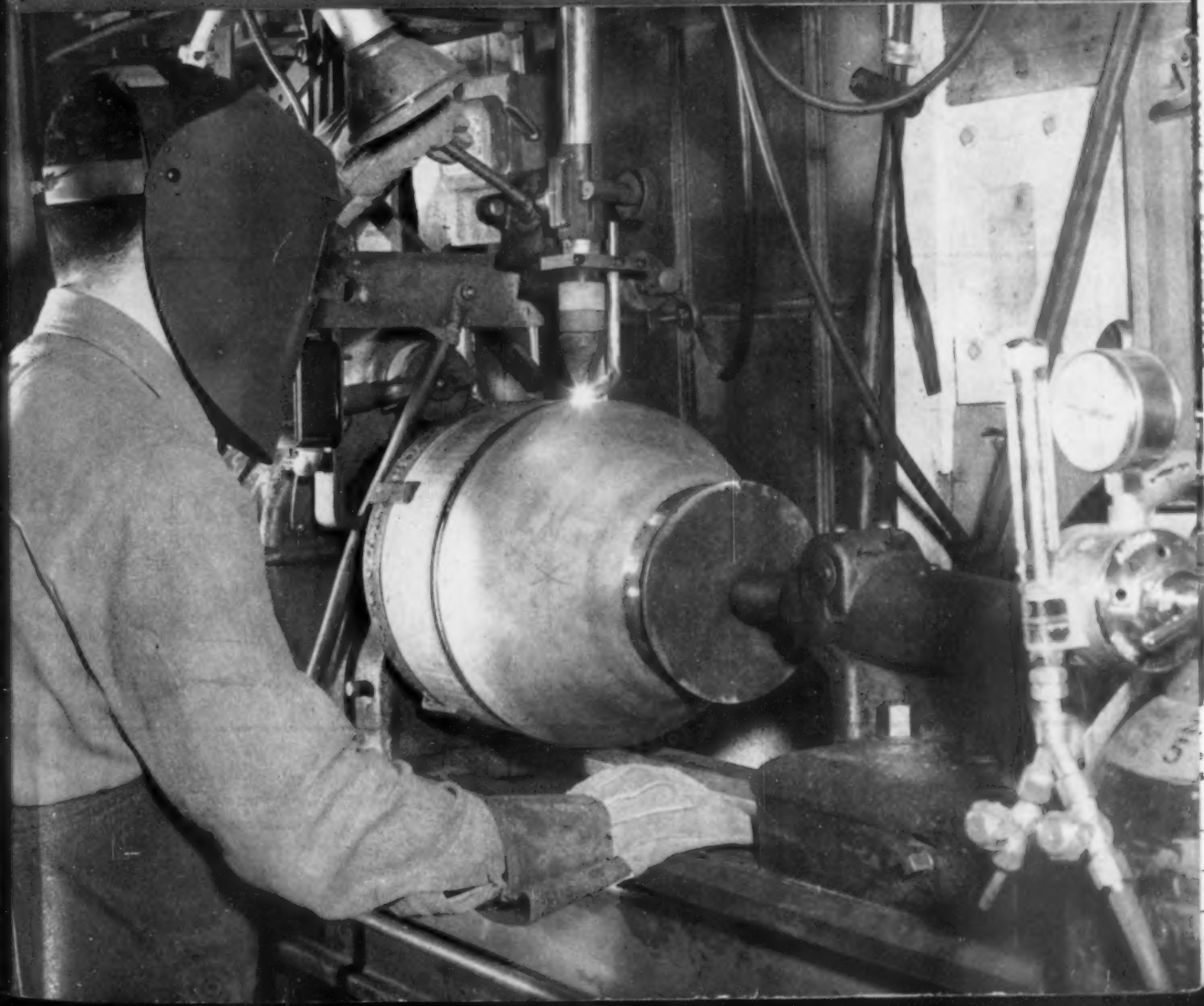
NOVEMBER, 1948

The WELDING JOURNAL

Official Publication of the American Welding Society



TWECOTONG
ELECTRODE HOLDERS

"Palms" Easily
Fits The Hand

A SIZE FOR YOUR JOB

No. A-532	$5/32$–$1/16$" Rod	200 Amps	$4.50
No. A-316	$3/16$–$1/16$" Rod	250 Amps	$4.75
No. A-14	$1/4$–$1/16$" Rod	300 Amps	$5.00
No. A-38	$3/8$–$3/32$" Rod	500 Amps	$6.50

WITH ALL THESE FEATURES

- Interchangeable Tip Insulators
- Insulated Spring — Neoprene Shielded
- 48 lb. to 157 lb. Tong Grip — Opens Wide
- Only 4 Simple Screws in TWECOTONG
- Clam or Solder Cable Connection
- Ventilated, Cool Running Handle
- Copper Alloy for Rugged Efficiency
- Detachable Handle Models Available

SUPER MULTI-LAYER GLASS CLOTH

TWECOTONG INSULATION*

Defies Heat and Impact • Tubular-Keyed Design • Interchangeable

AVAILABLE IN TWO GRADES

REGULAR Insulation (dark-yellow color) is standard on TWECOTONG Holders. It is tough and withstands greater heat and impact than other insulations with the exception of our recent development, "SUPER-MEL" Insulation.

"SUPER-MEL" Insulation (light-grey color) is recommended where heats are high and service is severe. "SUPER-MEL" will not carry welding current as will practically all other insulations after they have become arc-charred "SUPER-MEL" Insulation may be specified on your TWECOTONGS at a small extra charge. "SUPER-MEL" Tip Insulators are available as replacement parts and will interchange on any other TWECOTONG in the field.

Write or your copy of the TWECOLOG giving data and prices on America's only complete line of Electrode Holders, Ground Clamps, Connectors, Terminal-Connectors and TWECOLUGS for electric welding. See your TWECO distributor.

Tweco
MANUFACTURERS OF ELECTRODE HOLDERS • GROUND CLAMPS • CABLE CONNECTIONS FOR ELECTRIC WELDING
PRODUCTS COMPANY
1064 E. English Wichita 1, Kans.

Get HOBART arc welding and compare!

Results tell the story of Hobart supremacy

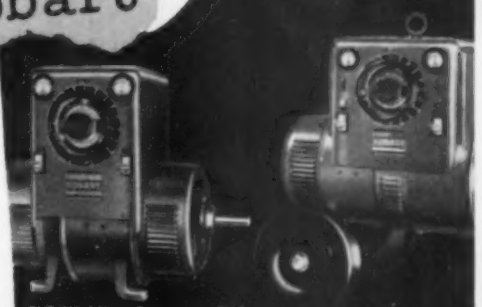
We like for you to be especially critical and demanding of absolute proof when you choose an arc welder for either DC or AC welding.

Why? Because in any comparison test you will find Hobart gives you outstanding performance on your welding jobs . . . more features of convenience . . . more advantages. Compare for faster welding, lower operating costs, and greater production. These things mean more profits for your business.

Investigate and choose a Hobart for your needs . . . compare it point for point with other machines . . . try it on some difficult welding application and prove to yourself Hobart's superiority.

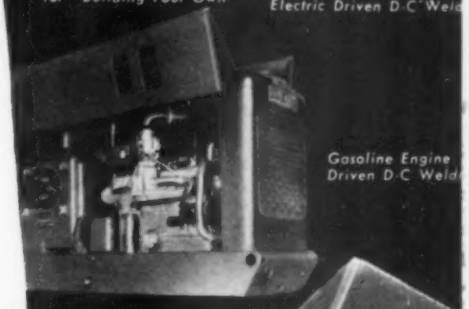
HOBART BROTHERS CO., Box WJ-118
Troy, Ohio

A-C "Heliarc" Arc Welder



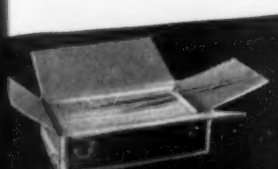
D-C Welding Generator Only for "Building Your Own"

Electric Driven D-C Welder



Gasoline Engine Driven D-C Welder

Combination A-C Welder plus A-C Power Unit



Hobart Electrodes are made to the most exacting specifications to give you better and stronger welds with greater ease.

Hobart Weldmobile
A complete portable welding shop

Most complete line of arc welders on the market

HOBART
one of the world's largest builders of
arc welders

HOBART BROTHERS CO., Box WJ-118 Troy, O.

I'd like more information on welding for:

☐ Electric Driven D-C Welder
☐ Gas Engine Drive D-C Welder
☐ Generator Only to "Build Your Own"
☐ A-C "Heliarc" Arc Welder
☐ A-C Welder plus A-C Power
☐ Hobart Weldmobile

Send Catalog on ☐ Arc Welders ☐ Accessories ☐ Electrodes

free

☐ Check here for your free copy of the Hobart Arc Welders Guide

Name _____

Address _____

the

WELDING JOURNAL

published for the advancement of the science and art of welding by the

AMERICAN WELDING SOCIETY

Editor

W. SPRARAGEN

OFFICERS

G. N. Sieger	*President*
O. B. J. Fraser	*1st Vice-President*
Harry W. Pierce	*2nd Vice-President*
R. S. Donald	*Treasurer*
J. G. Magrath	*Executive Secretary*
M. M. Kelly	*Secretary and Asst. Treas.*
Simon A. Greenberg	*Technical Secretary and Handbook Editor*

DISTRICT VICE-PRESIDENTS

District #1—New York and New England
George M. Trefts, III

District #2—Mid-Eastern
Gerard E. Claussen

District #3—Southern
R. E. Lorentz, Jr.

District #4—Central
Fred L. Plummer

District #5—Mid-Western
J. R. Wirt

District #6—Mid-Southern
Ray L. Townsend

District #7—Western
Gilbert S. Schaller

volume 27 NOVEMBER, 1948 *number 11*

CONTENTS

technical papers items and reports

Trends in Resistance Welding Here and Abroad, by F. R. Hensel and E. F. Holt 903
The Gas Shielded Metal Arc-Welding Process, by Jesse Sohn and A. N. Kugler 913
Automatic Arc-Welding Alloy Steel Plates, by Howard L. Miller 916
Current Welding Literature 920
The Stability of Oxyacetylene Flames, by Lewis D. Conta 921
Two Ways to Remove Frozen Nuts, by F. C. Giebig 928
Welding the Modern Diesel Locomotive, by H. S. Swan 929
Structural I-Beam Cutoff Machine, by George J. Strate 936
Metallizing as a Production Process, by Knowles B. Smith 941
Production Heli-Welding of Stainless Steel, by Bernard Blickman and Newton Blickman 945
Eccentric Guides Welding Head to Make Small Circular Welds 950

practical welder and designer

What Is the Best Way to Repair Cast Iron, by K. H. Koopman 951
Take Care of Small Castings, by H. B. Gilson 955
Another Easy Job for Your Blowpipe, by I. Kurzinski 955

society and related events

Society News 958
INDEX TO ADVERTISERS 960
Employment Service Bulletin 966
News of the Industry 968
New Literature 976
Personnel 980
New Products 986
Abstracts of Current Welding Patents 996
Section Activities 998

welding research supplement

Pressure Vessel Research 521-s
The Behavior of Prestretched Structural Steel Beams, by R. L. Buchwalter and Y. C. Shiu 522-s
Two New Methods for Testing Triaxial Specimens by Georges Welter 529-s
Research on Arc-Welded Butt Joints of Mild Steel, Discussion by F. J. Winsor 536-s
Plastic Behavior of Wide Flange Beams, by W. William Luxion and Bruce G. Johnston 538-s
Backups for Grooved Weld Joints, by Chester R. Austin and P. J. Rieppel 555-s
Some New Aspects of the Fatigue of Metals Brought Out by Brittle Transition Temperature Tests, Discussion by F. J. Winsor 568-s

cover: Automatic Heli-welding of stainless steel milk pails at the Oneida plant of the Hinman Milking Machine Co. Courtesy of Air Reduction Sales Co.

Published monthly by the American Welding Society. Publication office, 20th and Northampton Streets, Easton, Pa. Editorial and general offices, 33 West 39th St., New York 18, N. Y. Advertising office, 400 Madison Avenue, New York 17, N. Y., Telephone: Plaza 3-4466. Subscriptions $5.00 per year in United States and possessions; foreign countries $7.00. Single copies, nonmembers $.75; special issue October $1.00; members 50 cents. Entered as second-class matter January 15, 1932, tthe Post Office at Easton, Pa., under the act of March 3, 1879.

Copyright 1948, by the American Welding Society. The Society is not responsible for any statement made or opinion expressed in its publications. Permission is given to reprint any article after its date of publication provided proper credit is given.

The WELDING JOURNAL

volume 27 November 1948 number 11

Trends in Resistance Welding Here and Abroad

Automatic multiple spot-welding machines, electronic controls and new welding techniques have speeded up production throughout the industry. Devices for lowering peak power demands and developments in electrodes and electrode holders have also aided materially

by F. R. Hensel and E. F. Holt

PRODUCTION PRACTICES

THE trend in the United States to special resistance welding machines evident in past years is even more pronounced in present-day production practice. Substantial increases in the cost of labor and materials have necessitated improved and more economical fabricating techniques in the durable goods industry, particularly in those lines facing ever-increasing postwar competition. In such industries as the automotive, refrigeration and household appliances, the use of multiple spot-welding machines such as the hydromatic, ultra-speed, etc., which are tooled for specific applications, are being used to produce hundreds of welds in a period of time heretofore required to make a few welds using standard resistance welding equipment.

To cite a specific example, an unusual automatic multi-electrode spot-welding machine is used for welding corrugated stiffeners to the side sheets in the fabrication of railroad passenger cars. This machine, Fig. 1, has 40 electrodes, two electrodes being connected in series and each pair connected to a separate welding transformer. Each electrode has individual spring pressure adjustment. The lower electrode is a copper plate carrying the assemblies to be welded and the copper plate is attached to a table which automatically indexes under the row of electrodes, the indexing pattern being controlled by a photo electric tube and relay device.

Another high-speed multi-electrode welder having 88 electrodes is used in the fabrication of Quonset Huts. This machine has 88 separate transformers and is made in sections of 8 electrodes each, which can be fired simultaneously or individually, according to the available power facilities.

Both the upper and lower electrodes are movable so that uniform contact is assured on each electrode. The material used in the Quonset Huts is NAX Steel, which is somewhat scaly. The welding control automatically applies a preheat period to minimize the effect of surface scale and a postheat period to restore toughness to the welds in the hardenable NAX steel. The machine is designed for welding two thicknesses of 0.072-in. thick scaly steel, but it will weld up to two thicknesses of $^1/_8$-in. thick, pickled mild steel.

In Great Britain the trend is also to special purpose

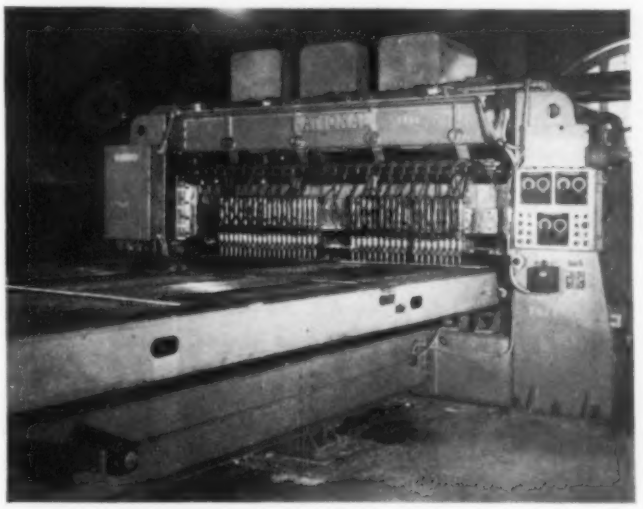


Fig. 1 Multi-point automatic spot welding machine

F. R. Hensel and **E. F. Holt** Vice-President in charge of Engineering and Research Engineer, respectively, with the P. R. Mallory Co., Inc., Indianapolis, Ind.

This paper consists of abstracts from lecture given before A.W.S., Mahoning Valley Section, Feb. 19, 1948, Youngstown, Ohio.

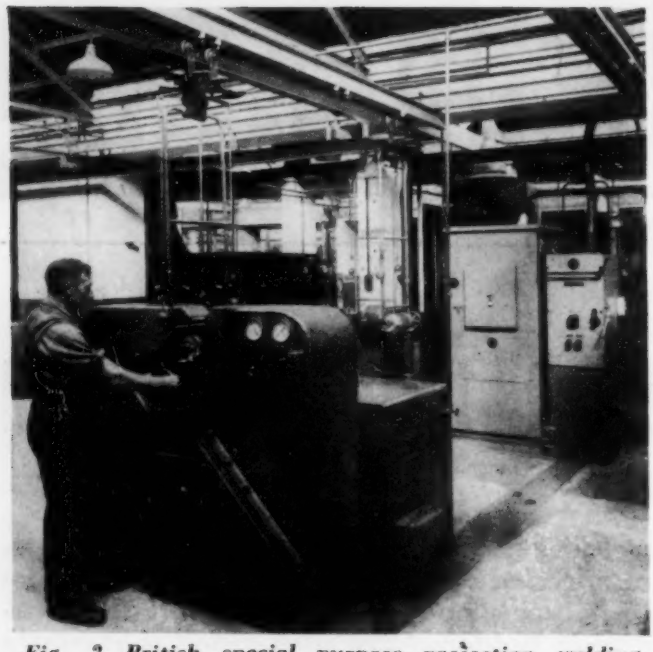


Fig 2 British special purpose projection welding machine

resistance welding machines. One such machine Fig. 2, is a 300-kva. series projection welder for welding two feet to the stator of a refrigeration motor. The stator is carried on a monorail and the unit is pushed into the machine by use of a hand wheel. A small platform lifts the stator up against the two electrodes attached to the side columns. The shaped electrodes are moved toward the stator pneumatically until a predetermined pressure is built up, at which point the ignitron control commences the welding cycle. The weld timer is a "woodpecker" (pulsation) control operating 20 cycles on, 10 cycles off for 3 pulsations. The stator, with the two feet welded in position, is then pushed through the machine to continue on the monorail to the next operation.

A British adaption of a standard welding machine to make two welds simultaneously is shown in Fig. 3 where the two upper electrodes are attached to the pistons of separate cylinders. The machine has two separate 25-kva. transformers.

The welders will not fire until the pressures in the two cylinders have been stabilized, at which time a pressure switch closes, initiating the thyratron timer. Prefabricated steel houses are popular in England and factory fabrication is largely accomplished using conveyer systems to advance the bulky structures.

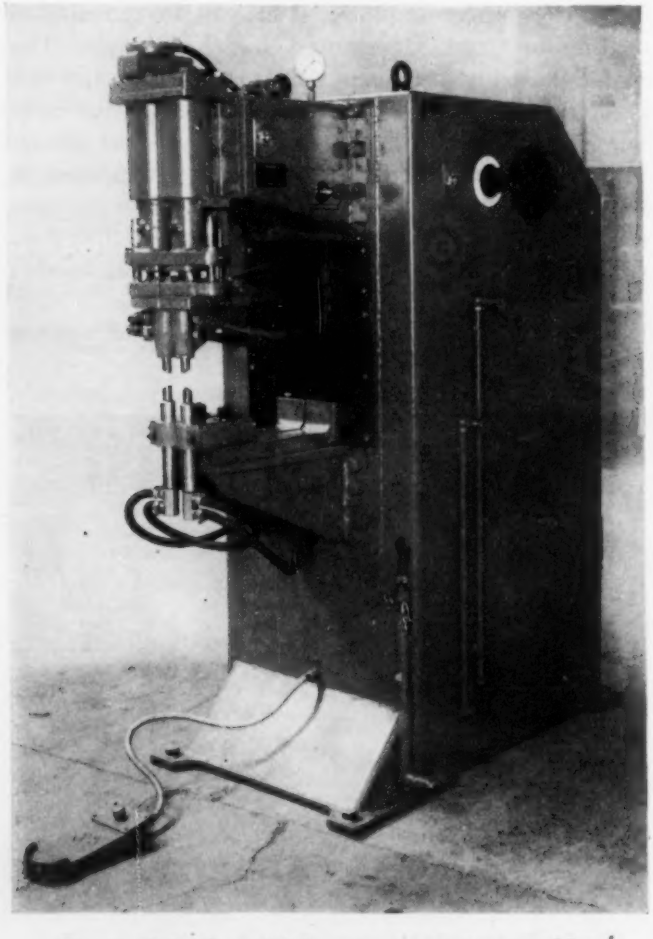


Fig. 3 British multiple spot, press type, welder

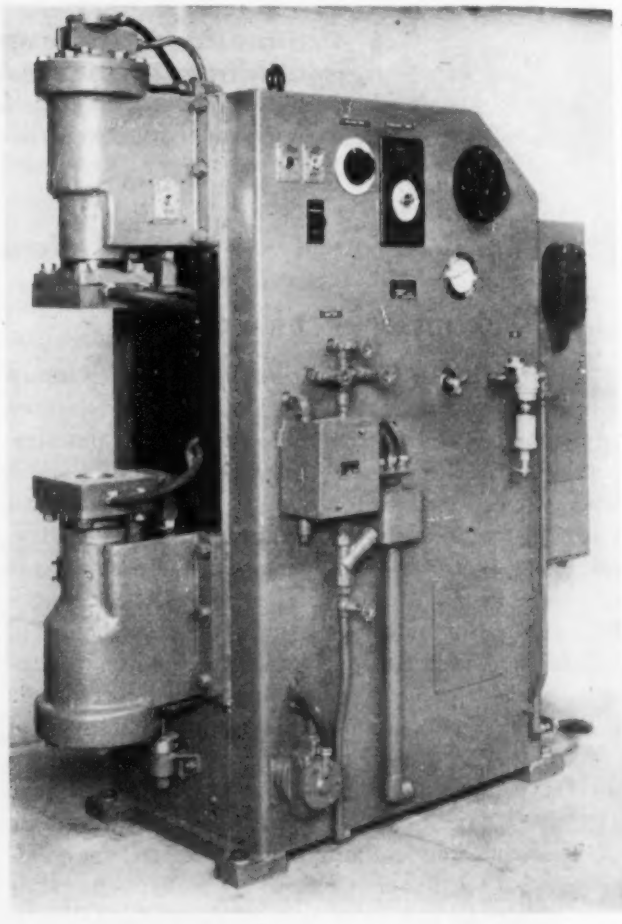


Fig. 4 British double piston, press type projection welder

A station in the conveyer line is a 100-kva. projection welder, Fig. 4 which has a movable lower electrode as well as the usual movable upper electrode. This is necessary since the large assembly must be lifted clear of the conveyer for welding. The machine is used in conjunction with another one of the same type mounted at the other side of the conveyer and the two machines

are so arranged that they are both controlled from one set of push buttons.

Controls

In the past few years resistance welding controls in the United States have undergone major revision and simplification, providing a much more compact unit and better accessibility to component parts. The newer controls are provided with standardized compartments into which may be plugged the "packaged" panels which provide the desired welding program. The controls are made relatively narrow so that they may be permanently fastened to the side of the welding machine. This permits resistance welder and control to be interconnected by the welding machine manufacturer and tested as a unit prior to shipment. The advisability of this proceudre is readily apparent since the majority of complaints on improper functioning of welding controls may be traced to faulty electrical connections or adjustments made by the user.

The British trend to simplified controls with emphasis on interchangeability of control components is indicated by Fig. 5, which is the latest tray type seam and spot welder control panel (British Thomson-Houston Co. Ltd.).

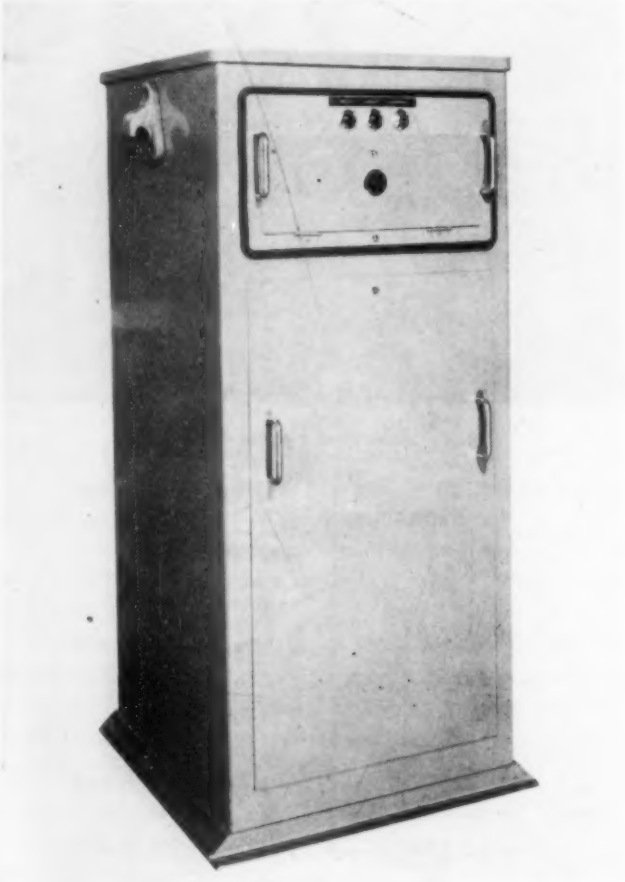


Fig. 5 British Thomson-Houston synchronous, tray type, welder control

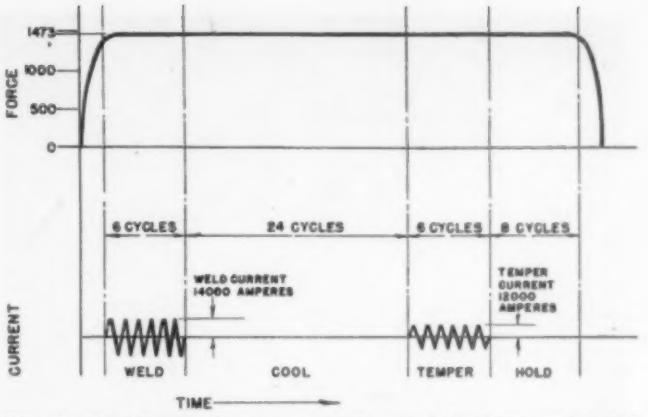


Fig. 6 Conditions for spot welding S.A.E. 1045 steel, 0.040 in. thickness, using $^1/_4$-in. diam. electrode face

The control components are self-contained in an interchangeable tray which slides out of the cabinet. Thus a spot-welding tray can be readily replaced with a seam welding tray. One feature of the control is the trigger tubes which have directly heated filament cathodes enabling the control to be used with a 1 min. warmup period. These trigger tubes are Xenon filled and have shield grids.

RESISTANCE WELDING TECHNIQUE

The technique developed during the war for obtaining spot welds of satisfactory ductility in the hardenable steels is now an established production procedure, although still limited in use. In the thinner gages of hardenable steels, conventional spot welding leaves the weld area extremely hard and brittle because the cooling rate is equivalent to a drastic quench.

In the hardened condition the tensile, impact and fatigue strength of the weld are extremely low.

Considerable toughness may be restored to spot welds in hardenable steels by applying a second pulse of current, usually of lower magnitude than the welding current, which in effect tempers the hardened weld area. Indicative of the technique for spot welding hardenable steels, Fig. 6 is a diagram of the current and pressure relationship for spot welding 0.040-in. thick S.A.E. 1045 steel. With a suitable electronic control the weld time, cool time and temper time are automatically obtained and the magnitude of weld and temper currents independently adjustable.

In spot welding of hardenable low-alloy steel plate in heavier gages a more elaborate heat-treating cycle is desirable to break up the cast columnar structure, refine the grain and temper the weld area. Electronic timers called program controls are used for this purpose, having as many as 10 or 12 timing intervals for such purposes as preheat weld, austemper, grain refine, temper, etc.

Satisfactory spot welds may be obtained in the spot welding of heavy gage, scaly, structural steel using a welding sequence which provides a preheating period at high pressure followed by a high welding current at moderate pressure. The preheating period limits the

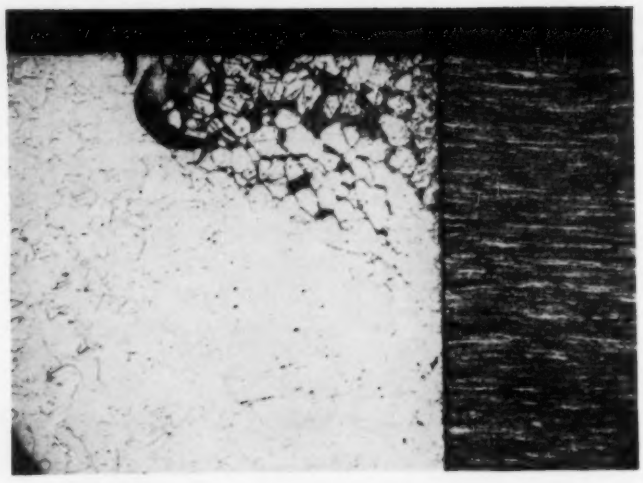


Fig. 7 Structure in typical tungsten-nickel resistance butt weld magnification—50 diam.

temperature rise between the electrodes and stock, avoiding arcing or burning, until sufficiently intimate contact is obtained, permitting the high-welding current to be subsequently applied without undue surface disturbance.

The welding sequence is automatically controlled in three stages:

1. High force—low current-preheat
2. Low force—high current—weld
3. High force for forging

Although welds of satisfactory strength may be obtained in scaly steel it is to be expected that electrode life will not be as great as can be obtained on cleaned steel.

In resistance welding dissimilar metals and alloys, many rather unusual expedients are employed to obtain a proper heat balance and welds of reliable strength One example of this is a technique or process developed immediately prior to the war by Mallory for joining a small piece of pure tungsten to the end of a nickel alloy rod. The assembly was a center electrode, extensively used in aircraft spark plugs, the tungsten being the sparking tip, having a high resistance to electrical erosion. The spindle was nickel and the wide dissimilarity in physical and metallurgical properties of the two materials resulted in a difficult combination to join by conventional resistance welding methods.

Straight resistance butt welding of tungsten to nickel was found unreliable, since sufficient heat could not be localized at the interface of the materials. The photomicrograph, Fig. 7, at 50 diam., shows the structure of a typical butt weld at the interface of the tungsten and nickel. An overheated area in the nickel slightly below the weld line extends partly around the periphery of the nickel. This is a "die burn" which was difficult to avoid even with a collet type clamping of the nickel.

No disturbance had occurred in the fibrous structure of the tungsten, indicating that the temperature at the interface was relatively low.

Alternating-current flash welding produced welds of satisfactory strength although considerable burn-off of the nickel alloy was required. High current density on upset resulted in die burns. Inasmuch as the tungsten was only $^1/_4$ in. long (0.160-in. diam.) the welding face was so close to the collet that flash was thrown into the collet mechanism eventually fouling the moving parts. A process was developed which we called "Flash-Arc" welding since the operation was more closely related to arc welding than resistance welding.

The process just described, and eminently successful in welding the tungsten and nickel, basically consists of clamping the materials in work-holding clamps, bringing them together under pressure and initiating a direct current of moderate value (200 to 300 amp.). When the current reaches a steady state the materials are automatically separated a predetermined distance and an intense arc continues for a measured period, at the end of which the parts are forced together with considerable force and impact. This extinguishes the arc, welds the components together and expels molten metal or undesirable compounds from the joint. The direct current is subsequently terminated. The collet then releases the tungsten component, the head retracts and the welded assembly is ejected by a blast of air. The entire sequencing is automatic—the operator merely loads the parts. The sequencing is mechanical as disclosed in Fig. 8, which is a photograph

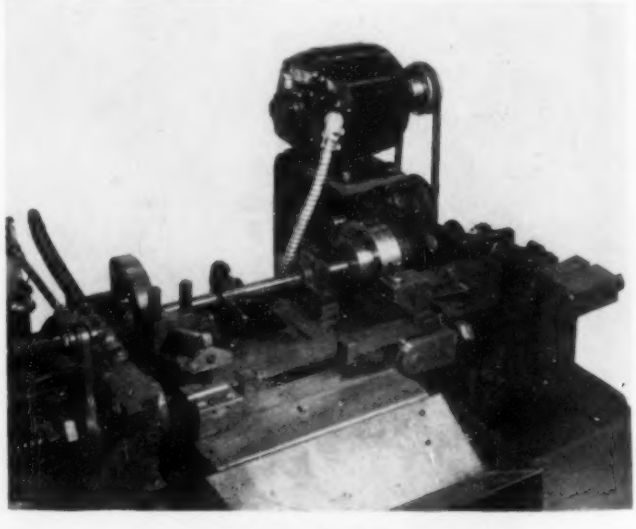


Fig. 8 Automatic flash-arc welder

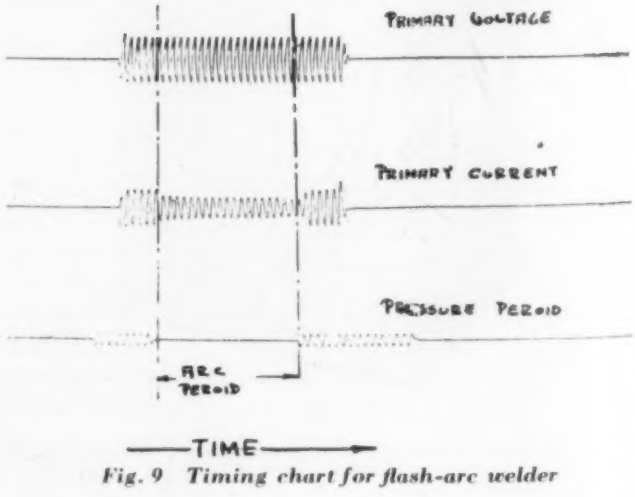


Fig. 9 Timing chart for flash-arc welder

of one of the production welders with all covers removed. A small cover is brought down over the work during arcing, protecting the operator from eye injury or ultraviolet burns.

The direct current is supplied by a 3-phase dry disk rectifier. The pressure and current relationship may be determined from oscillographic recordings. Figure 9 is a reproduction of a Brush Oscillograph chart and the sequencing is as follows:

1. Parts together—pressure applied
2. Current initiated
3. Parts separated—arc occurs. 60-cycle current wave (18 cycles)
4. Parts forced together—pressure applied
5. Current interrupted
6. Pressure released

The microstructures of Flash-Arc welds discloses considerable recrystallization in the tungsten adjacent to the weld line evidenced by the band of equiaxed

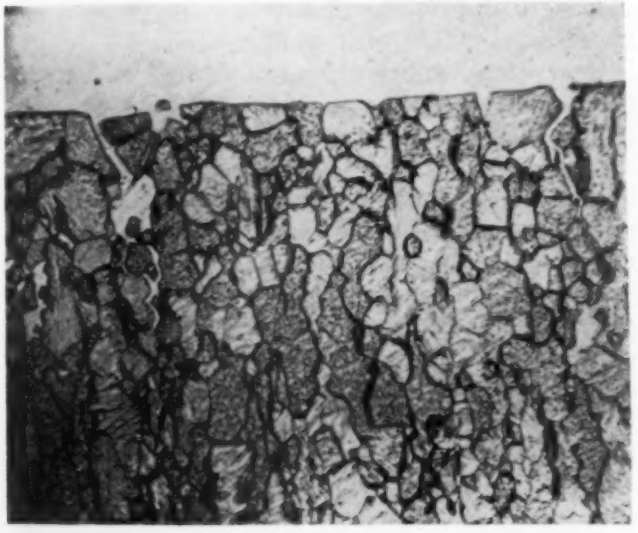


Fig. 10 Typical structure of tungsten-nickel flash-arc weld

grains. This is a measure of the relatively high temperature attained at the surface of the material, although the actual weld is apparently very superficial since alloy constituents of nickel and tungsten are difficult to resolve even at high magnification.

The high impact force applied to effect welding, extrudes molten nickel alloy into the grain boundaries of the tungsten (Fig. 10–500 ×).

Ultimate tensile strengths of from 50,000 to 60,000 psi. are obtained, fractures invariably occurring in the tungsten adjacent the weld. At the end of the war, 10 of these machines were producing about 2 million center electrodes per month.

LOW POWER DEMAND RESISTANCE WELDERS

In many localities the resistance welding process has outstripped existing power facilities and American welding machine manufacturers have brought out an increasing number of improvements to reduce the high kva. demand common to conventional single-phase a. c. welders.

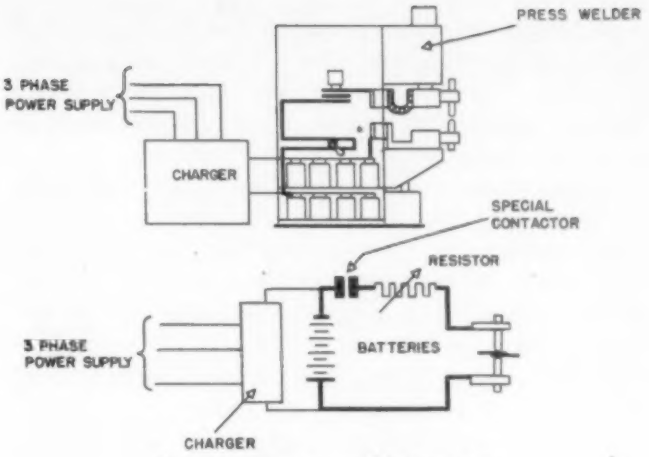


Fig. 11 Battery-welder system

The development of the indirect stored energy resistance welding equipment materially aided in the spot welding of the light alloys. This permitted balancing the load on 3-phase power supply systems and supplying the high energy power to the weld with a low kva. demand.

These systems, which use either the electromagnetic or electrostatic principles, are limited in application by reason of their relative inflexibility in the rate of energy discharge and the total energy available for welding. They are unsuited for spot, seam or projection welding of heavier gages of metals. Among the newer resistance welding systems designed to balance the welder load on 3 phases with high power factor and low kva. demand, are: (1) Storage battery system, (2) Three-phase, sometimes called frequency converter system, (3) Kinetic energy storage welder and (4) Dry disk rectifier or tri-phase system.

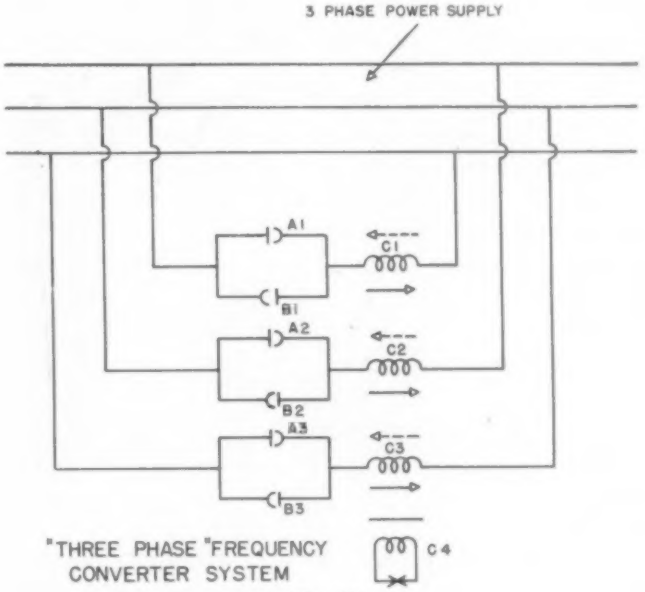


Fig. 12

In the storage battery welders the welding current is obtained directly from a bank of heavy duty storage batteries. The batteries are internally water cooled and are connected in suitable series—parallel banks to obtain welding currents as high as 50,000 amp.

In the battery welder the welding current itself must be interrupted and the successful operation of this system relies upon a heavy duty pneumatically operated contactor controller which uses large carbon-graphite disks for making and breaking the circuit. This contactor permits interruption of up to 50,000-amp direct current with virtually no sparking and works on the principle of the carbon pile resistor.

Figure 11 illustrates the elements of this system. The batteries are kept charged by a battery charger (usually a dry disk type rectifier) operated from a 3-phase power supply. The power demand is low and the power factor high. In Fig. 11, is shown the electrical circuit and how the components are inter-connected.

The basic electrical elements of the three-phase system are illustrated in Fig. 12 where the welding transformer has three separate primary windings and one low voltage secondary. By suitable control one ignitron in each phase is allowed to become conductive for a preset interval permitting current to flow through the coils in the direction shown by the solid arrows. The first group of ignitrons is rendered nonconductive and current flows through the other group for the same period, allowing current to flow through the windings in the direction shown by the dotted arrows. Thus the current in the primaries is reversed periodically at a predetermined rate and in turn so is the magnetic flux in the core and this is reflected in the secondary. The frequency of the secondary wave can therefore be made low, such as 4 to 10 cycles per second, thus inductive reactance is very materially reduced, skin effect is decreased and the introduction of iron into the welder throat does not affect the magnitude of the welding current. The purpose of the periodic reversal of the welding current is to avoid saturation of the transformer. The system therefore operates at high power factor and the circuit draws almost balanced 3-phase power.

A comparative test (Fig. 13), between a single-phase and a 3-phase welder in spot welding 1/4-in. thick steel under similar welding conditions showed that the power required on the 3-phase welder was only 44% of that required by the single-phase machine.

Material spot welded..... 1/4- x 1/4-in clean mild steel
Weld force..... 4000 lb
Weld time..... 2.3 sec
Electrodes..... 5/8-in face diameter

Type welder	Nominal welder rating, Kva	Throat depth, in	Weld shear strength, lb /-spot	Primary current, amp/-phase	Primary voltage	Power Input, Kva
Single phase	250	20.5	17,600	558	442	247
Three phase	135	24.5	18,200	143	438	108

Fig. 13 Power requirements of single-phase and 3-phase (Sciaky) welders in spot welding steel plate

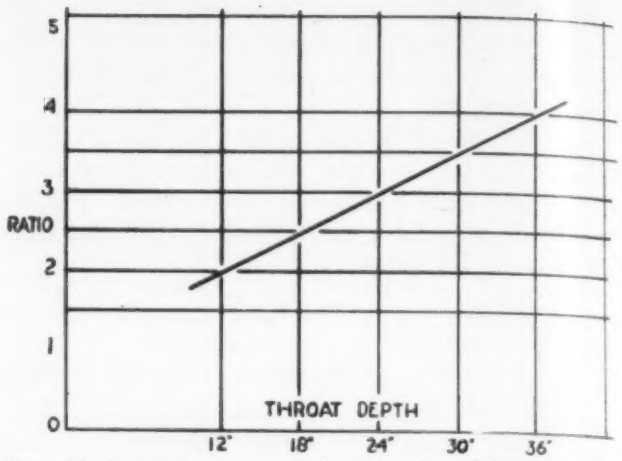


Fig. 14 Frequency conversion on size 3 RWMA press welder

Figure 14 indicates the ratio of kva. demand of 3-phase and single-phase welders producing the same secondary currents. The advantages of the 3-phase welder become more pronounced as the throat depth increases.

Heavy-duty welders which require high welding currents advantageously employ the 3-phase system. A 3-phase dry disk rectifier capable of delivering d. c. current directly to the weld makes it possible to produce a 3-phase lower kva. demand than the conventional single-phase welder and is another answer to the problem of lowering the high kva. demand. This principle can be applied to seam, spot, projection or flash welding. The rectifier stacks have a long life, may be small in size as compared to other types of electrical components and are of rugged construction. The high current, low voltage magnesium-copper sulphide rectifier which will operate at temperatures as high as 150–200° C. is particularly suited. The rectifiers adapt themselves to a welder load by being capable of supplying heavy short-time current overloads, with no-load power consumption being practically nil.

A 3-phase full wave rectifier circuit is used to obtain the most economical transformer design and the most satisfactory direct current wave form (Fig. 15). The dry disk rectifier type of machine uses rectifier transformers instead of a welding transformer. The 3-phase full wave circuit is more efficient and economical in

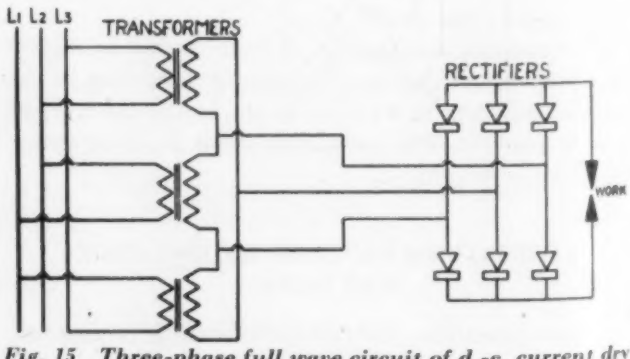


Fig. 15 Three-phase full wave circuit of d.-c. current dry disk rectifier

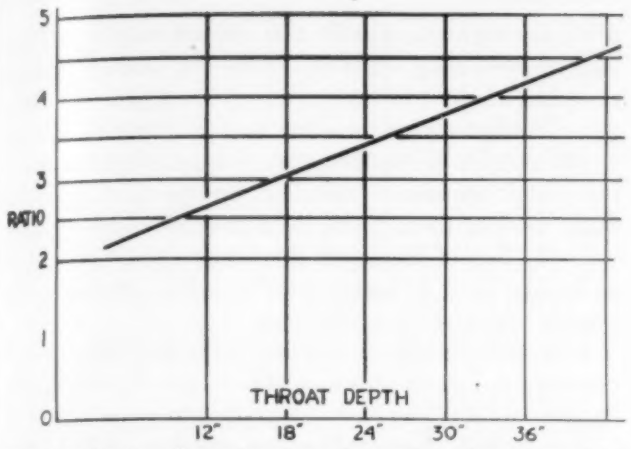


Fig. 16 Ratio of single-phase kva. to 3-phase kva. (dry disk rectifier) on size 3 RWMA press welder

comparison with a 3-phase half wave circuit. Since the welding current is d. c., the effect of the size and shape of the secondary is less noticeable as to reactive electrical losses. Figure 16 shows a comparison of the ratio of the 3-phase kva. demands of a dry disk rectifier machine in comparison with a single-phase a.-c. machine producing the same secondary currents. Here again the ratio increases with increasing throat depth.

Due to the values of resistance and inductance usually found in a welding machine, the rate of rise of current in a dry disk rectifier machine is rather slow, making it particularly desirable for projection and upset welding.

The lower rate of current rise provides more time for the metals to come in intimate contact. Since the rectifier units are essentially resistance devices, the power factor will be between 90 and 100%, and the current wave is without the discontinuity which is present when using rectifier tubes. With the use of the 3-phase full wave circuit, the primary current will be almost perfectly balanced.

The external appearance of the dry disk rectifier welder "tri-phase" is similar to a conventional machine, the rectifier and its transformers being self-contained inside the machine.

The kinetic stored energy resistance welding system is a very recent development making use of some of the oldest and best-known electrical principles in providing a high electrical (direct current) energy for welding.

Fundamentally it is a combination of a homopolar d.-c. generator, and a heavy flywheel driven by a conventional a.-c. motor. Although the homopolar generator is the oldest type of generator, it has been little used, since its chief characteristic is that it produces continuous d. c. of high amperage and relatively low voltage. (A homopolar generator has only one pole, continuous collector rings instead of a commutator.) These characteristics, required for resistance welding, are seldom met with elsewhere in industry, accounting for the fact that so few homopolar generators have been put to commercial use.

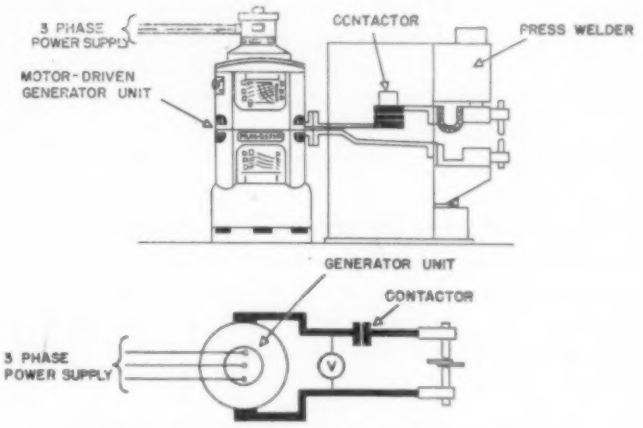


Fig. 17 Kinetic energy welder system

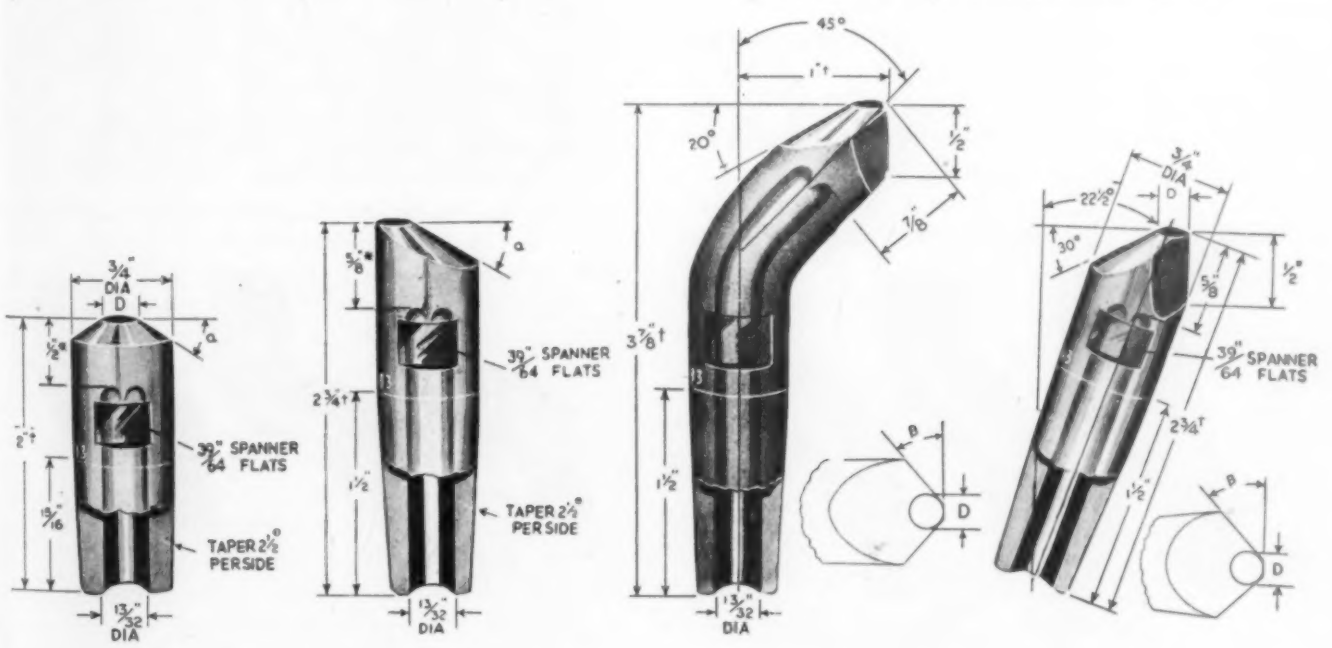


Fig. 18 Typical standardized spot-welding electrodes used in Great Britain

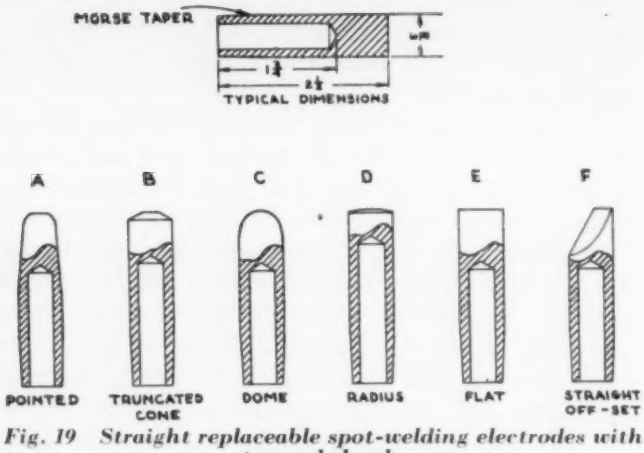


Fig. 19 Straight replaceable spot-welding electrodes with tapered shanks

It would not be feasible to build a generator so large as to generate—by itself—the large currents required for resistance welding. In the kinetic energy system, a large flywheel is connected to the generator. In this flywheel, kinetic energy is stored during the "off time" between welds, and when the machine is first started up.

When the welding contactor is closed, the heavy current drawn tends to stall the generator. This tendency is overcome by the kinetic energy in the flywheel to such an extent that only a minor slowing down of a few revolutions per minute occurs.

In Fig. 17 the method of coupling the generator to the welder requires the high welding current to be interrupted directly, and this is done with the same type of pneumatically operated carbon pile contactor as is used in the storage battery welder. The schematic electrical diagram is also illustrated.

ELECTRODE AND ELECTRODE HOLDER DEVELOPMENTS

The electrode materials produced in Britain by the Mallory Metallurgical Products Ltd. are similar to the alloys and refractory compounds used in this country. In Germany, mostly pure copper was in use and some copper alloys containing 5–8% silver.

New materials in the electrode field are copper zirconium alloys with third and fourth metal additions such as cadmium, cobalt and beryllium. We investigated these alloy series before the war and commercial products are just now reaching the market. The copper-zirconium-cadmium alloy is very promising since it will not crack when operated at elevated temperatures and has shown excellent results when used for seam welding terne plate, mild steel or stainless steel.

In the line of Elkonites the tungsten carbide-copper materials have a higher conductivity, gradually replacing the older type Elkonites.

Although lacking the widely diversified selection of standardized electrodes available in the United States, British spot-welding electrodes reflect good basic design.

The British Standardized replaceable spot-welding electrodes (see Fig. 18) have a shank taper of $2^1/_2$ in. per side or 5° included angle as compared to Morse tapers used in this country. Morse tapers have about a 1° 26 sec. taper per side or an included angle of about 2° 52 sec.

The English electrode standards require a taper length of one and one-quarter times the electrode diameter in cases where the thrust is in line with the taper shank and two times the electrode diameter in cases where the electrodes are eccentrically loaded. Thus in Fig. 18 the offset type electrodes have $1^1/_2$-in. taper length while the centered tip has a $^{15}/_{16}$-in. taper length. The greater taper angle permits the electrode to be

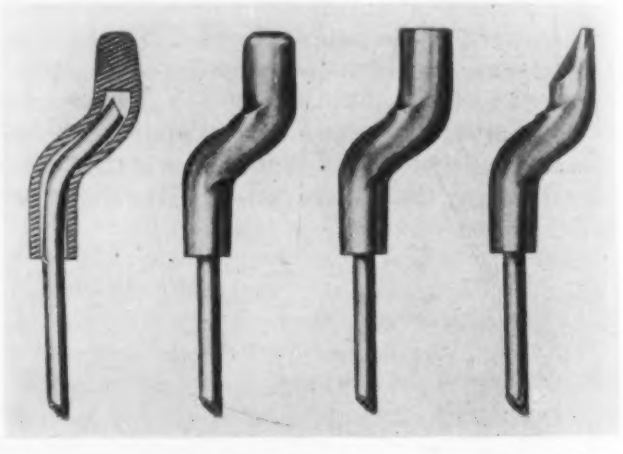
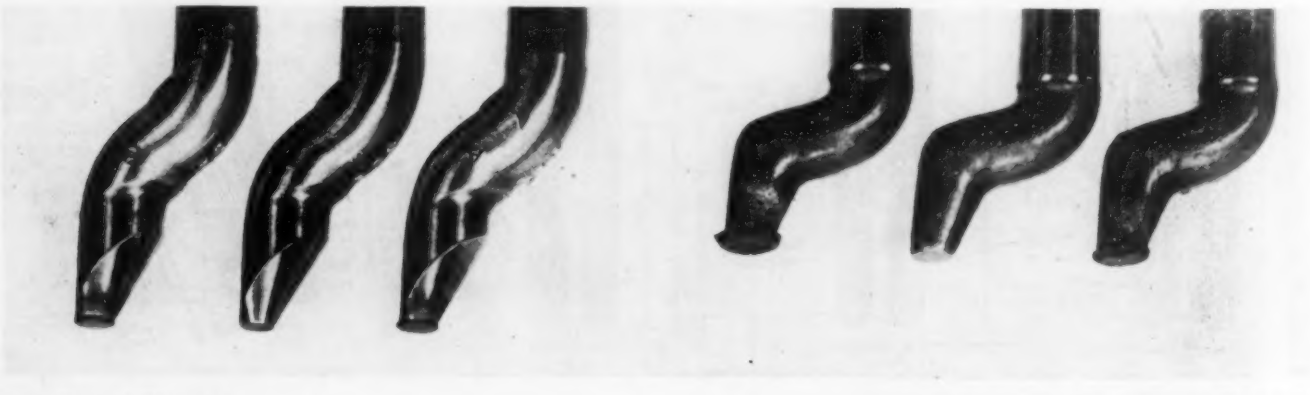


Fig. 20 New, bent type, internally water cooled, offset electrodes



Drop Forged Electrodes — *New Internally Cooled Bent Electrodes*

Appearance of tips after making good spot welds

Fig. 21

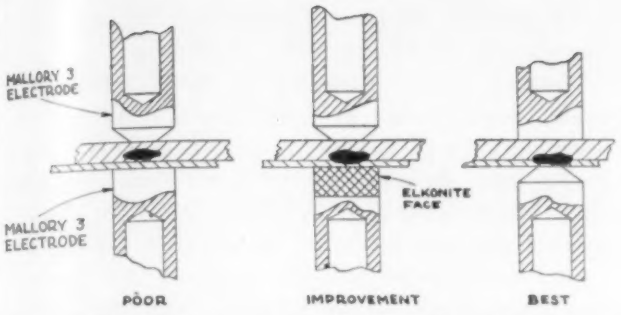


*Fig. 22 **Heat balance as affected by electrode contour when welding steel of dissimilar thickness***

extracted from its holder more readily and the electrodes are supplied with wrench flats so that a standard open-end wrench can be used to remove the tips.

Almost invariably the face contour of the British spot-welding electrodes used on steels conforms to a truncated cone and the preferred included face angle is 120°, or 30°-rake angle. Face angles greater than 120° included (rake angle less than 30°) involve greater difficulty in aligning the tips and accurately positioning the components where locating jigs are not used while included angles less than 120° (rake angles greater than 30°) result in more rapid "mushrooming" of the electrode. The AMERICAN WELDING SOCIETY in their "Recommended Practices" promote the use of truncated cone face electrodes with a 20°-rake angle.

The standardized British taper shank electrodes are available in $^1/_2$, $^3/_4$ and 1 in. diam., while the American electrodes with Morse taper shanks are available in 0.482, $^5/_8$ and $^7/_8$ in. diam. Standardized taper shank electrodes in the United States are available in an ever-increasing number of face contours as illustrated in Fig. 19, such as offset, flat, radius, dome, truncated cone and pointed, the pointed tip still being the most popular for the production welding of steel sheets.

Irregular offset electrodes are extensively used and the newer internally cooled bent type offset electrodes, Fig. 20, are expected to replace to a considerable extent cast or drop forged irregular offset electrodes, because of more efficient water cooling and higher physical properties such as hardness and yield strength.

The internally cooled offset electrodes are produced by bending a full hard standard straight electrode using an ingenious bending technique. The internal water cooling tube is inserted in the tip prior to bending, assuring the proper location of the tube up in the tip. Offsets ranging from $^1/_8$ to $1^1/_2$ in. are standardized and the tips may have either No. 1 or No. 2 Morse tapers.

An indication of the benefits which may be derived using the more efficiently cooled bent type spot welding electrodes is apparent from the photograph, Fig. 21 which shows the appearance of drop forged offset electrodes and the newer water cooled bent electrodes of comparable external design after having made 5000 spot welds each on 0.052-in. C.R. steel. The weld time was 20 cycles, 40 welds per minute, the weld shear strength in each case being 1700 to 1900 lb. per spot weld. The per cent increase in face area of the solid forged tips was one and one-half times that of the water-cooled electrodes. In addition, the surface appearance and symmetry of the welds obtained using the water cooled tips was substantially better.

The water-cooled offset electrodes should prove valuable in spot welding of aluminum alloys where the "pick-up" of the aluminum on the electrode face has been extremely troublesome.

Maintaining lower electrode temperatures will minimize tip "pick-up," decrease the frequency of tip cleaning and improve the electrode life.

In the welding of materials of different thickness or in the welding of dissimilar materials, the proper selection of suitable electrode contours or electrode materials is important in obtaining the correct heat balance. An example of good and bad heat balance in welding different thicknesses of metal is shown in Fig. 22. The best heat balance in this case was obtained using a pointed electrode against the thinner metal and a more flat electrode against the heavier stock. Figure 23 illustrates a method of obtaining a correct heat balance in the spot welding of dissimilar metals.

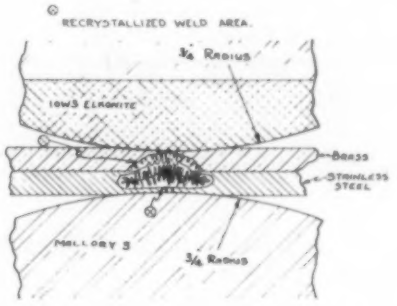


*Fig. 23 **Improvement in heat balance using dissimilar electrode materials***

In welding of high-conductivity brass to low-conductivity stainless steel, an Elkonite-faced electrode of about 30% IACS conductivity is used against brass and

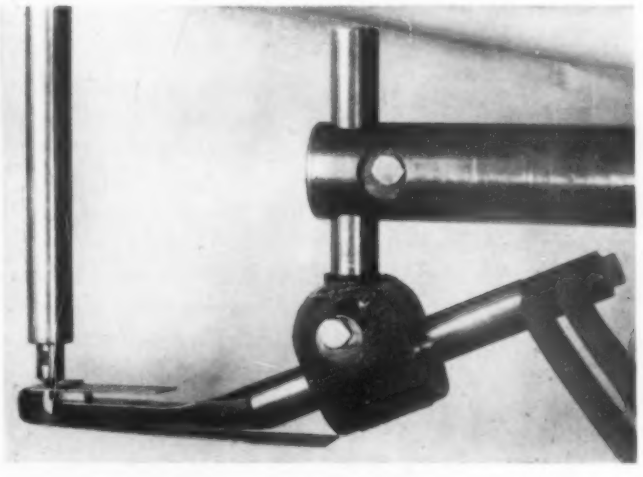


*Fig. 21 **British universal offset electrode holder***

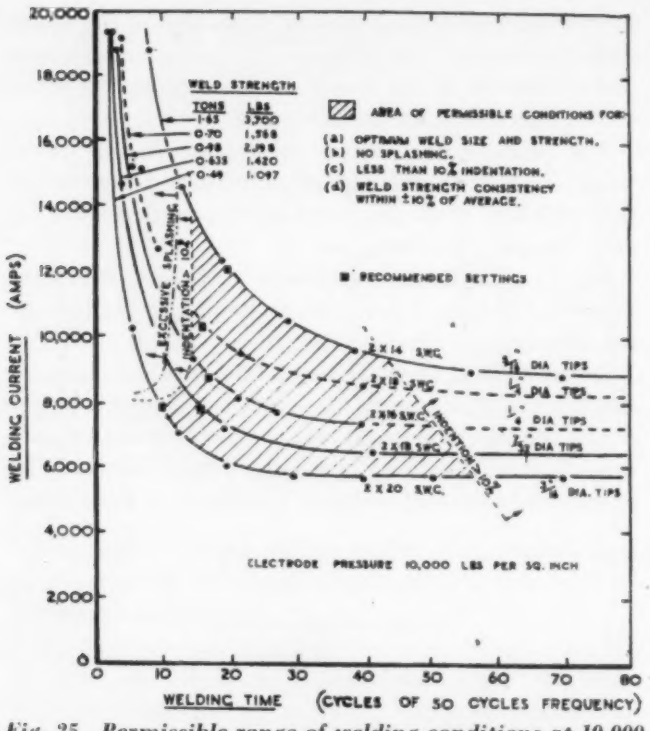


Fig. 25 Permissible range of welding conditions at 10,000 psi. electrode pressure for producing spot welds in 20, 18, 16 and 14 S.W.G. mild steel (S.B. 4)

a Mallory 3 electrode of 80% IACS conductivity is used against stainless steel.

In Great Britain considerable use is made of Universal offset electrode holders, Fig. 24 illustrating a popular type which is available in various angles such as $22\frac{1}{2}°$ and $67\frac{1}{2}°$. This adapter will also clamp a holder in a horizontal position by removing the clamp bolt assembly and placing it in the angle hole.

In the newer developments of d.-c. welding systems the welding current is almost entirely limited by the ohmic resistance. For maximum efficiency the electrode holders, electrodes and for that matter any other current carrying components in the secondary circuit should have the highest possible electrical conductivity.

The possibility of increased electrode pick-up in d.-c. welding of light alloys due to polarity effects needs further checking.

RECOMMENDED PRACTICES

The American Welding Society has published in tabular form a series of Recommended Practices for Resistance Welding. We shall select only one typical example. For the spot welding of mild steel, a single set of welding conditions is listed for each thickness of material to be welded.

The recommended conditions given are those deemed to be optimum and since it is recognized that mild steel can be spot welded over a rather wide set of conditions it has been argued whether it would not be advisable to recommend a permissible range of conditions for each gage.

The British are getting ready to issue Recommended Practices for Resistance Welding. They prefer to present the data in the form of curves (Fig. 25), in order to indicate a range of permissible conditions.

The shaded area represents the permissible range of welding currents and weld time based on using a unit electrode force of 10,000 psi. on flat-faced electrodes. An optimum set of conditions is represented by solid blocks on each curve. The A.W.S. recommendations give net electrode forces to be used with a given electrode face diameter and the resultant unit pressures vary from 10,000 to 15,000 psi. American practice usually considers 15,000 psi. (on mild steel) as most suitable.

The British recommendations do not give the user an indication of suitable welding conditions should the 10,000 psi. be higher than could be applied with a particular machine.

The optimum diameter of the electrode face according to British practice is calculated from the formula $d = \sqrt{T}$, where d is the face diameter and T is the thickness of one sheet, the actual electrode diameter being made to the closest $^1/_{32}$ in. The A.W.S. method of recommending one optimum set of conditions from which to work permits all the conditions for various gages of stock to be presented in one single table although the user may be somewhat at a loss if his machine cannot meet one or more of the recommended conditions.

British practice indicates that with optimum spot-welding conditions the weld should meet certain geometrical requirements as sketched in Fig. 26.

RESEARCH ACTIVITIES

In this country the Welding Research Council through its Resistance Welding Research Committee, has sponsored a program in Resistance Welding Research to broaden our basic knowledge of the process and to develop new techniques, establishing procedures and conditions of practical use to the industry.

Currently under active investigation are such projects as Projection Welding of Steels, Spot Welding of Heavier Gages of Steel, Contact Resistance, Flash Welding and Fatigue Strength of Spot Welds.

A free interchange of technical knowledge in resistance welding is maintained between the Welding Research Council and the British Welding Research Association.

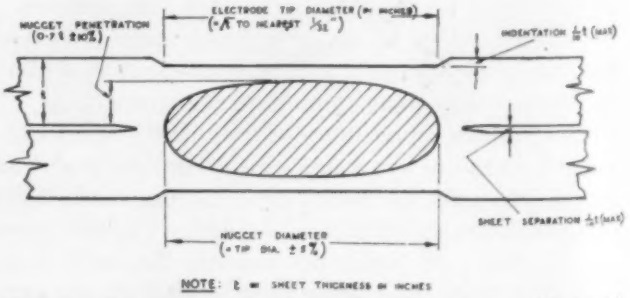


Fig. 26 Recommended dimensions for spot welds in 14, 16, 18 and 20 S.W.G. steel sheet

The Gas Shielded Metal Arc-Welding Process

A new development in which a bare wire arc is shielded by gas. Means are provided for manual and automatic welding

by Jesse S. Sohn and A. N. Kugler

FOR many years it has been recognized that existing welding processes are not completely satisfactory for the joining of many metals. This deficiency is particularly apparent when welding relatively heavy sections in the vertical and overhead positions, and is accentuated when working with nonferrous metals. In an effort to develop a better welding process, attention has been directed to the development of a method in which a consumable filler wire is continually deposited in a controlled gaseous atmosphere. The problems surrounding this new approach have been many, involving new concepts of a combination of factors including current density, gas shielding and filler wire feed speeds. The results of this program have been most successful, culminating in the development of a new process known as the *Aircomatic Process*.* It may also be designated as gas shielded metal arc welding.

Briefly, this new process consists of feeding a bare or processed filler metal in wire form through a suitable holder. This filler metal carries welding current and an arc is maintained between the end of the wire and the work. Power may be supplied from a standard welding generator. The arc is maintained within a controlled envelope of shielding gas. The equipment developed for the process includes both a manual gun and automatic head.

With the manual unit, welding may be performed in all positions, i.e., flat, horizontal, vertical and overhead. All of the standard joint designs may be welded in these positions. Single or multilayer welds can be deposited using either beading or weaving techniques. Vertical welds may be made with either upward or downward travel. In short, all the facility associated with metal arc welding of steel is made available by this process, plus the advantages of a high deposition rate resulting from continuous filler metal feed and the absence of slag. As far as it is now known, this is the first time that continuous wire feed has been employed for practical welding in the vertical and overhead positions. Continuing research indicates quite definitely that this process is capable of welding many metals.

The Aircomatic Process is particularly adapted to the welding of aluminum and its alloys. It has been found that direct current, reversed polarity, provides the necessary arc conditions. Standard d.-c. welding generators, including constant potential multiple operator units, are suitable for this work. Argon has been found to be a satisfactory shielding gas for aluminum welding. The welding grade argon currently supplied for Heli-welding is suitrble.

One of the principal features of this process is the use of very high current densities. Current densities twelve times those used in ordinary metal arc welding have been successfully employed. With such high current densities it becomes necessary to provide high rates of filler metal feed in order to make satisfactory welds. Filler wire speeds for the manual welding gun range from 100 to 300 in. per minute.

The arc obtained with this process may be described as a nonsensitive arc, since changes in arc length result in smaller changes in arc voltage than are encountered in normal metal arc welding. Observation of the arc discloses that it consists of a relatively narrow incandescent core surrounded by an umbrella-shaped envelope. The outer envelope of the arc provides a cleaning action thus eliminating the need for welding fluxes.

For the manual welding of aluminum as currently provided in this process, only three sizes of filler metal are needed—viz., $^3/_{64}$, $^1/_{16}$ and $^3/_{32}$ in. With these filler metal sizes the over-all current range is

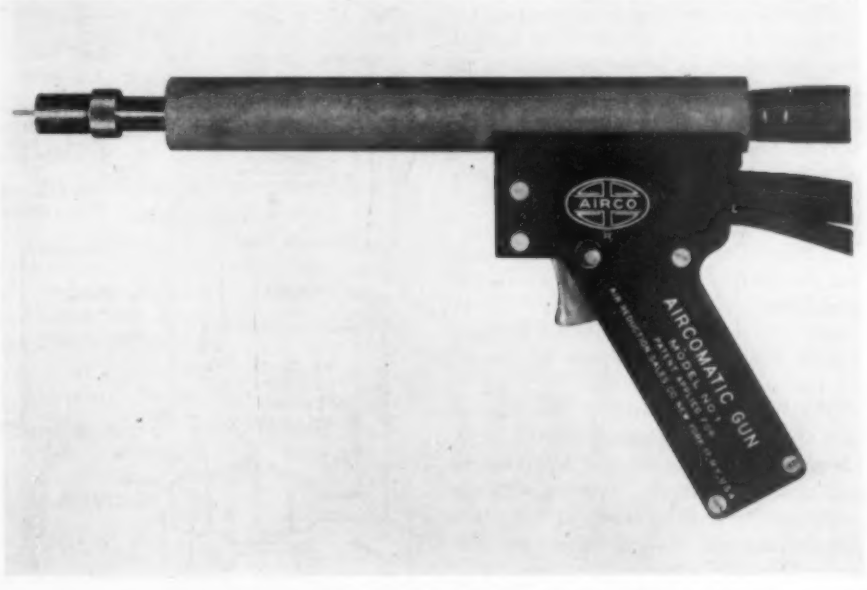


Fig. 1 Manual gun for inert gas metal arc welding of aluminum

Jesse S. Sohn is with the Air Reduction Labs, Murray Hill, N. J. and **A. N. Kugler** is with the Technical Sales Div. of Air Reduction Sales Co., New York, N. Y.

This paper was presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

* Patents applied for.

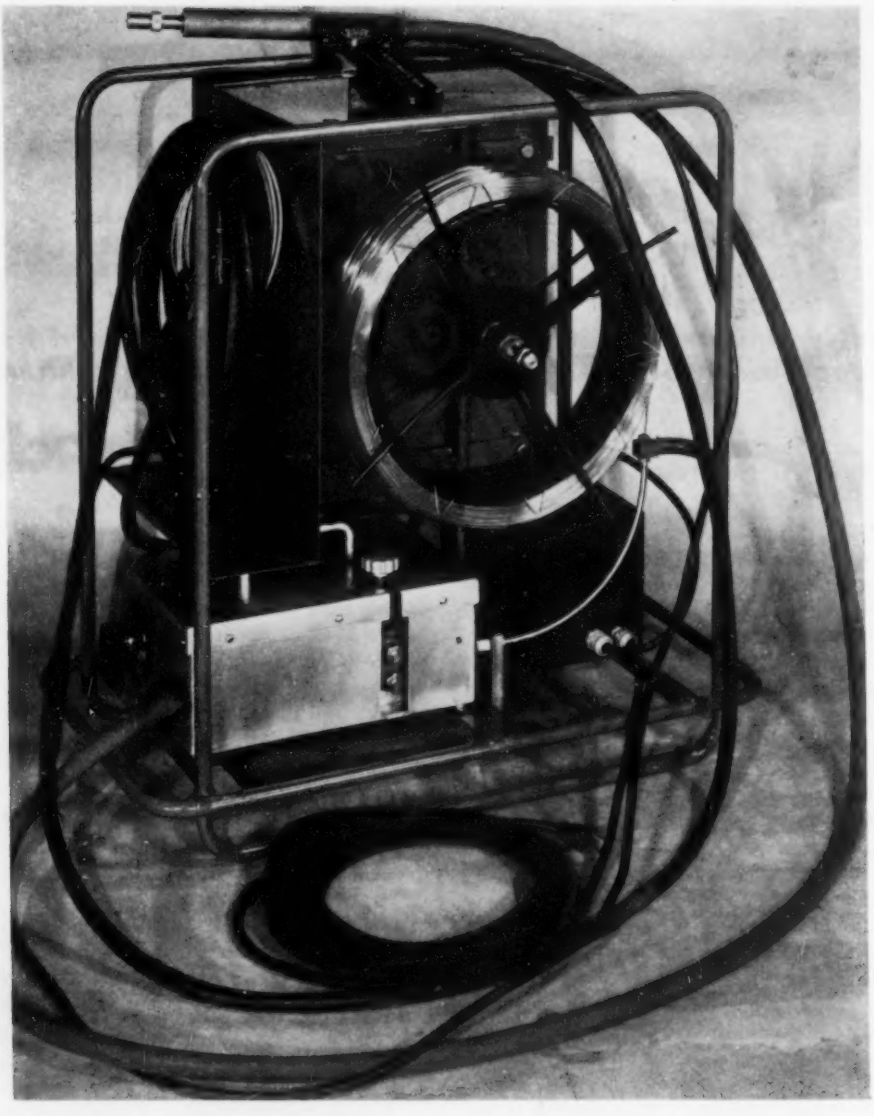


Fig. 2 Equipment for manual inert gas metal arc welding of aluminum

70–450 amp. which permits welding of metal thicknesses from $^1/_8$ up to 2 in. and more.

The selection of filler metal composition is governed by the metal to be welded. For the welding of 2S and 3S material, 2S wire is recommended; for 52S and 61S material, either the 43S or 716 analyses may be used. This process affords promise of reducing some of the limitations now encountered in the welding of heat-treatable aluminum alloys.

A manual unit is commercially available for the gas shielded metal arc welding of aluminum and its alloys. Figure 1 illustrates the gun used for manual welding. Figure 2 shows the complete equipment for manual welding.

The component parts of the manual unit are illustrated schematically in Fig. 3, along with the necessary d.-c. power source and cylinder of argon. Starting with the welding gun, it will be observed that it has (1) an attached welding cable from the generator; (2) a gas (argon) hose, concentric with which is the metallic tube for conveying the filler metal wire and (3) a small, three-conductor control cable. It will also be observed that the gas hose and wire conductor are connected, at the other end, to the feed motor box; the control cable also connects with this box. This feed motor box contains the governor-controlled motor, speed reducer, feed rolls and a solenoid valve. The control box, which is connected by the three-conductor control cable to both the gun and the feed motor box, contains the relays which control operation of the wire feed. The remaining piece of equipment is the wire reel for the filler metal.

The gun, pictured diagrammatically in Fig. 4, is equipped with a trigger which readies the unit for welding and a "jog button" for feeding wire when not welding. To start welding, the trigger is depressed (it may lock in the "on" position by means of a button) and this starts the argon flow which purges the lines. Next the electrode, which should project $^1/_2$ to $^3/_4$ in. from the gas nozzle, is scratched on the work and when arc voltage is established, the controls operate to energize the feed motor and deliver filler metal. If desired, a current contactor may be placed in the welding circuit and connected through the control circuit to be operated by the trigger on the gun. When using a contactor the trigger is used for starting and stopping the welding. One of the advantages of using a contactor is that the gun is "dead" when the trigger is in the released position.

A study of Fig. 3 will show the general paths of the argon shielding gas and welding current. From this it will be noted that the gun is essentially simple, since most of the control and driving mechanisms have been placed in the other units. The argon passes down the "barrel" of the gun and issues from the gas nozzle around the wire electrode. Since both the gas nozzle and the wire guide tube are close to the welding arc they will gradually deteriorate and are therefore expendable items. In consequence these parts are of simple construction to permit of rapid and economical replacement.

Tracing the path of the filler metal wire from the gun to the feed motor box it will be seen that the wire and the argon are carried in one conductor. The feed motor

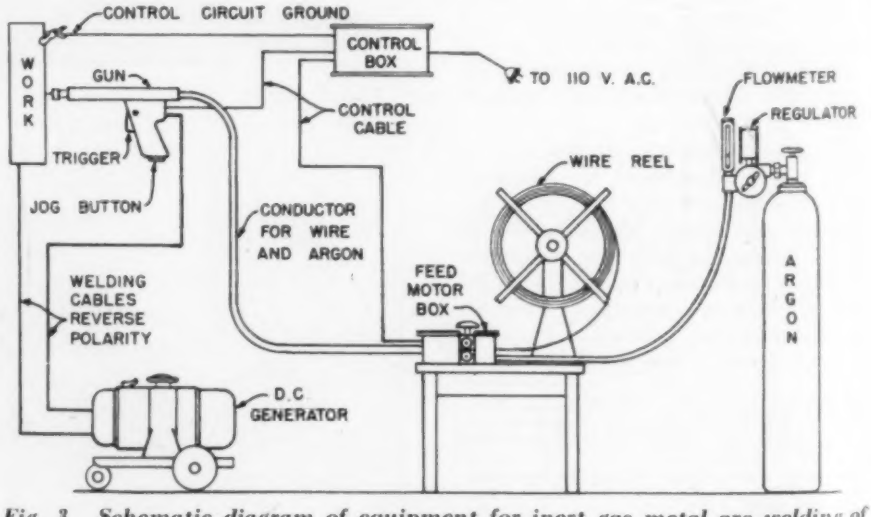


Fig. 3 Schematic diagram of equipment for inert gas metal arc welding of aluminum

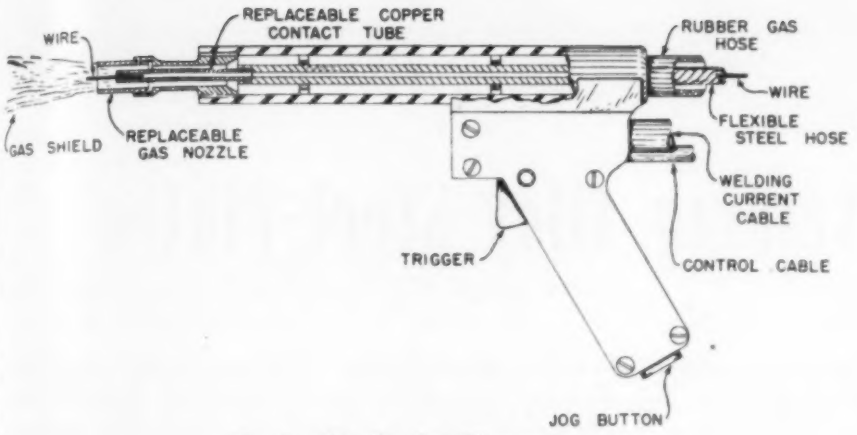


Fig. 4 Details of welding gun

box contains the governor-controlled driving motor which provides the variable speeds necessary for the filler metal feed. This motor, operating on a 110-v. circuit, drives a pair of feed rolls through a speed reducer. The rolls draw the filler metal wire from the reel and propell it to the gun. This box also contains the solenoid valve which turns "on" and shuts "off" the flow of argon as controlled by the trigger on the gun. From the solenoid valve the gas is fed to the combination gas-wire feed conductor by means of a plastic hose and a tee connection.

The control box houses the transformer which provides the low voltage necessary for the control circuit. It also contains the relays which control the operation of the wire feed motor. The control cable from this box leads to both the gun and the feed motor box. An additional conductor leads from the box to the work and provides the ground for the control circuit.

The speed of wire feed is controlled by a manually set, mechanically governed motor. This speed, once established, remains constant regardless of what takes place at the welding arc. Selection of a welding current and a wire feed speed for a given size of filler wire results in a definite arc length and hence arc voltage. Thus, changes in arc length may be accomplished by either of the following methods (1) by varying the wire feed speed through the governor on the motor or (2) by changing the current. In the first instance, assuming a given welding generator setting, increases in wire feed speed result in a decrease in arc voltage; obviously, such a decrease in arc voltage is accompanied by an increase in welding current, the value depending upon the characteristics of the d.-c. generator used. It follows that decreases in wire feed speed have the opposite effect. In the second instance, assuming constant wire feed speed, changes in welding generator setting result in an increase in arc voltage when the machine setting is raised and a decrease when the machine setting is raised and a decrease when the setting is lowered. This inherent self-regulation of the arc resulting from the specific combination of a drooping generator characteristic and high burn-off rate makes this welding process essentially automatic.

In welding with the gas shielded metal arc-welding process, the arc is initiated by scratching the electrode rather than tapping. When the arc is established the gun is moved so as to have the shield about $^1/_2$ in. from the work. For welding the gun is held so that it points ahead in the direction of welding, i.e., forehand welding as defined for the oxyacetylene process. To terminate a weld, when no welding current contactor is used, the arc is broken with a quick snap. If a contactor is used in the circuit, releasing the trigger on the gun cuts welding power, wire feed and argon flow. The length of the arc should be $^1/_{16}$ to $^3/_{16}$ in. In addition, holding the gas nozzle much over $^1/_2$ in. from the work will reduce the effectiveness of the gas shield. Incomplete shielding results in the formation of a "crust" on the surface of the weld.

For welding aluminum by this process it has been found that the flow of argon is not critical as long as it is maintained within reasonable limits. When welding with the manual gun, argon flows between 20 and 50 cu. ft. per hour are used. In general the lower flows are for low current values and the higher flows for the larger currents. Also, the minimum flows may only be used with short, gas nozzle-to-work distances. Greater distances or drafty conditions will require more gas flow. Once the flow has been determined for a given welding condition it may be varied by as much as plus or minus 10% without adversely affecting the welding operation. It has been demonstrated experimentally that up to 20% more argon will be needed when welding fillet welds on tee joints, in order to provide shielding gas at the root of the joint.

Mechanical properties of aluminum welds are equal to the properties obtained in castings of the same analysis as the filler metal. The quality of welds produced in aluminum by this process is dependent upon many variables. It may be stated generally that the welds will be superior to welds made with aluminum metal arc electrodes; further, under proper conditions the quality will approach that obtainable with the inert gas-tungsten arc method. The welds are of excellent surface appearance. Porosity may be encountered in aluminum welds and is of two distinct types: internal porosity readily visible with radiographic techniques and microporosity not detectable using normal radiographic procedures. The former is subject to control while the latter appears to be associated with most rapidly cooled cast aluminum alloys. Tensile strengths of 27,000 psi. with 8 to 10% elongation have been obtained on 43S all-weld metal specimens welded in the vertical position. In addition to the previously mentioned precautions, it is recommended that both aluminum base metal and filler metal be cleaned to insure the production of high quality welds.

Attention is directed to the fact that welding of heavy aluminum sections may be accomplished with little or no preheat. This practice is in sharp contrast to other processes wherein the filler metal is added by indirect methods.

CONCLUSIONS

The Aircomatic welding process in effect combines the desirable features of both metal arc welding and inert gas shielded arc welding. It offers the following distinct advantages:

1. A manual welding process with the essential features of automatic welding.
2. Continuous deposition of filler metal at high rates.
3. Manual manipulation of an automatic process for welding in a vertical and overhead position.
4. High quality weld metal deposits.
5. Minimum edge preparation owing to deep penetration.
6. Ability to weld heavy sections with little or no preheat.
7. No flux required; slag removal eliminated.
8. Visible arc; no blind welding.

Automatic Arc-Welding Alloy Steel Plates

Development of high-strength weldable alloy steel plate. Unrestrained welding conditions, low-hydrogen type flux, and small deposits are helpful in borderline cases. Ferrite-forming alloys are preferable to the carbide-forming alloys

by Howard L. Miller

THE aim of the author in presenting this paper is to show the interested members of the welding profession that there are probably a considerable number of chemical analyses that could be used in making up high-strength steel plates for welded applications, which as yet have not been given consideration by the code committee of the A.S.M.E. and A.S.T.M.

The straight nickel steel and the straight molybdenum steels are quite difficult to produce at the present time and probably in the future, as all melts of steel in the alloy divisions are showing fairly heavy residuals of nickel, chrome and molybdenum, due to the mixed alloy scrap from the war conditions. It is commercially very unprofitable and metallurgically almost impossible to produce the straight single-type alloys as mentioned.

We took the straight $2^1/_2\%$ nickel (with 0.31% residual chromium) steel as a basis of comparison (A.S.T.M. A203) and made automatic submerged arc butt welds on five other steels, and from the welded samples we cut the required tensile and bend tests for A.S.T.M. code tests. Hardness surveys in the welded zone both in as-welded and stress-relieved condition were made. Hand weld bead hardness tests were also made to determine the effect of tack welds on the parent metal and were set up in $^1/_8$-, $^3/_{32}$-, $^3/_{16}$- and $^3/_8$-in. size rods with proper amperage for each size.

A full study of the microsections in the welded zones was made. In all the samples so studied we found no abnormal structures or anything from grain structures or hardness in the welding zones to indicate that any of these analyses would cause difficulty with respect to cooling cracks or underbead cracking, as long as the welding conditions as to amperage, type of flux, rod type and size and speed of travel or deposition were maintained as in these tests, and also that the metal on both sides of the welded seam is free to move in with the cooling of the fused metal.

Proper layout and design of the shells or parts to be welded with regard to freedom of movement during the welding operations would contribute much to the success of automatic welding but, where such freedom of movement with cooling strains is not possible, it will be better to use hand deposition of weld metal in such small increments that the over-all total expansion and contraction of the parts during welding and cooling will be of a low enough order of magnitude that shrinkage cracks should not occur.

With regard to the A.S.M.E.-A.S.T.M. cold-bend

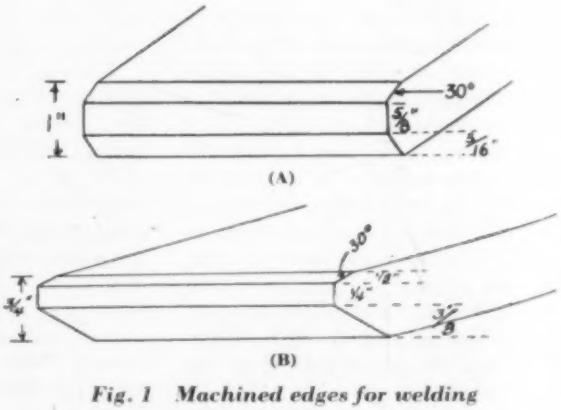


Fig. 1 Machined edges for welding

Howard L. Miller, Metallurgist, Railroad Development, Republic Steel Corp. Cleveland, Ohio.

This paper was presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

Table 1—Analyses of the 6 Steels

Steel	*C*	*Mn*	*P*	*S*	*Si*	*Ni*	*Cr*	*Cu*	*Mo*	*V*
1	0.149	0.62	0.013	0.028	0.20	2.40	0.31	...	0.08	...
2	0.133	1.00	0.029	0.021	0.27	...	...	...	...	0.08
3	0.197	0.86	0.032	0.019	0.25	1.84	0.16	...	0.33	...
4	0.116	0.74	0.029	0.019	0.01	1.35	0.01	1.02	0.22	...
5	0.16	1.45	0.017	0.038	0.21	0.53	0.02	0.08	0.48	0.08
6	0.16	1.30	0.013	0.024	0.25	1.68	0.04	0.23	0.21	0.11

tests on welded specimens of plate, the more we perform this test, the less respect we have for it as a criterion of quality in welded joints. In such tests on alloy high-tensile steel weldments there is a great deal of "scatter" in the results obtained, even when cut from the same section of weld. The practical value of such a test based on fully machined and polished surfaces, rounded edges, etc., when such conditions as regards to surface are practically never found in service, strikes the writer as being practically negligible. We do not grind welded seams flat to surface in commercially welded pressure vessels or boilers. We do not expect any of these sections to bend along or across the welded joints in service and any stress that exceeds the elastic limit of the steel in the part is away beyond the stress expected in operation. Fatigue failures always originate at points of stress concentration. The rate of fatigue crack progression is definitely related to the notch toughness of the adjacent material and at the temperature of service.

Table 2—Physical Tests on the Welded Plates Both in the As-Welded and Stress-Relieved Condition

Test	*Yield strength, psi.*	*Tensile strength, psi.*	*Per Cent Elongation in 4 in.*	*Nature of fracture*
		Steel 1—2½% Nickel		
Long. A.R.*	62,100	82,000	26.0	½ in. from weld
Long. A.R.*	62,800	82,400	26.0	¼ in. from weld
Long. S.R.†	60,600	78,700	28.0	½ in. from weld
Long. S.R.†	61,100	79,100	30.0	¼ in. from weld
Trans. A.R.	63,800	83,200	21.5	¾ in. from weld
Trans. A.R.	64,700	82,700	21.0	¼ in from weld
Trans. S.R.	62,700	79,700	24.0	½ in. from weld
Trans. S.R.	61,800	79,300	24.0	½ in. from weld
		Steel 2 Mn Va		
		Welded with L-70 electrode		
Long. A.R.	58,500	76,200	26.0	1 in. from weld
Long. A.R.	59,000	77,100	29.0	1 in. from weld
Long. S.R.	61,400	78,200	28.0	¾ in. from weld
Long. S.R.	61,600	78,500	26.5	¾ in. from weld
Trans. A.R.	57,800	76,000	22.0	1 in. from weld
Trans. A.R.	57,600	76,200	22.0	1 in. from weld
Trans. S.R.	58,500	77,500	24.0	¾ in. from weld
Trans. S.R.	59,500	78,200	23.0	¾ in. from weld
		Welded with Mn Va electrode		
Long. A.R.	60,300	76,800	24.0	1 in. from weld
Long. A.R.	59,500	76,900	24.0	¾ in. from weld
Long. S.R.	59,200	77,200	27.0	¾ in. from weld
Long. S.R.	59,800	78,000	25.0	1 in. from weld
Trans. A.R.	60,500	77,700	21.5	½ in. from weld
Trans. A.R.	61,600	78,600	23.0	½ in. from weld
Trans. S.R.	59,500	78,200	23.0	¾ in. from weld
Trans. S.R.	59,100	78,900	23.0	1 in. from weld
		Steel 3 Ni Mo		
Long. A.R.	‡	104,000	30	1 in. from weld (cup)
Long. A.R.	...	104,750	29	½ in. from weld (½ cup)
Long. S.R.	...	99,440	35	1 in. from weld (cup)
Long. S.R.	...	100,000	34	¾ in. from weld (cup)
Trans. A.R.	...	103,100	13	½ in. from weld (seam)
Trans. A.R.	...	100,400	9	Edge of weld
Trans. S.R.	...	97,400	19	In weld
Trans. S.R	...	98,180	21	Edge of weld
		Steel 4 Ni Cu Mo		
Long. A.R.	...	81,320	40	1 in. from weld
Long. A.R.	...	75,260	40	1½ in. from weld
Long. S.R.	67,650	81,220	45	½ in. from weld
Long. S.R.	69,510	82,464	20	In weld
Trans. A.R.	...	79,030	34	1 in. from weld
Trans. A.R.	...	77,980	34	1 in. from weld
Trans. S.R.	69,880	81,560	38	1 in. from weld
Trans. S.R.	70,070	82,100	39	1 in. from weld
		Steel 5 Mn Va Ni Mo		
Long. Q.T.	85,700	106,900	20.0	1 in. from weld
Long. Q.T.	84,300	106,500	19.5	1 in. from weld
Trans. Q.T.	83,800	104,300	4.5	In weld
Trans. Q.T.	90,900	106,500	5.5	In weld
		Steel 6 Mn Va Ni Mo		
Long. N.T.	‡	91,360	21.0	1½ in. from weld
Long. N.T.	...	94,620	20.5	1½ in. from weld
Trans. N.T.	...	91,480	15.0	1½ in. from weld
Trans. N.T.	...	93,360	15.5	1½ in. from weld

* A.R., as-welded.
† S.R., stress relieved.
‡ Yield points were not obtained on these specimens as no perceptible drop in the beam was observed.

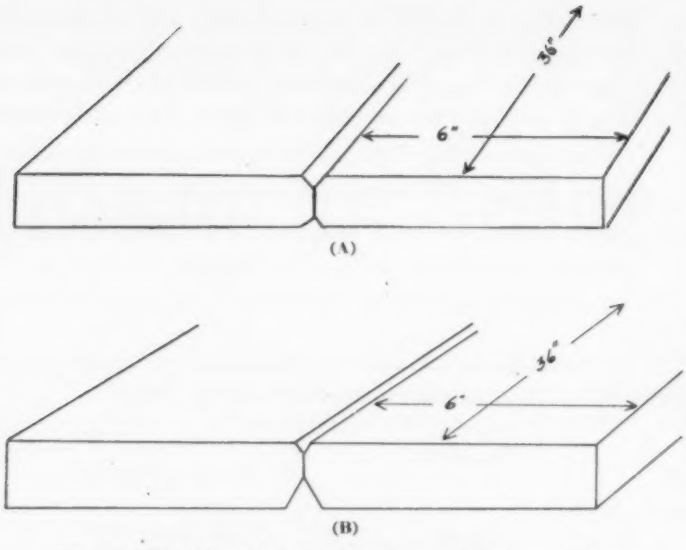


Fig. 2 Machined edges placed together for welding

We have also found that there is not a direct relationship between the hardness of a part of a welded zone and its notch toughness at various temperatures. The low hydrogen type of flux has definitely given a great improvement to the toughness of the harder welds and it is difficult now to definitely state that a certain maximum hardness reading in a weld zone should be the limit for acceptable material or practice. We had such a specification calling for rejection of material showing over 300 Vickers hardness in a test bead zone for certain ordnance steels during the war. Later developments in welding treated armor plate with high hardness welds made with ferritic as well as austenitic rods with full mineral coatings definitely proved in actual firing tests that gun carriage elements so fabricated would stand up under very drastic firing conditions as to temperature and excess loading.

The bend tests on $^3/_4$-in. or heavier, plate welds, when

Table 3—Plate and Weld Analyses, Compared

Steel	*Location*	*C*	*Mn*	*P*	*S*	*Si*	*Ni*	*Cr*	*Cu*	*Mo*	*V*
1	Plate	0.149	0.62	0.013	0.028	0.20	2.40	0.31	...	0.08	...
	Weld	0.089	0.82	0.019	0.034	0.20	1.63	0.19	...	0.34	...
2	Plate	0.133	1.00	0.029	0.021	0.27	0.08	0.05	...	0.02	0.08
	Weld—L-70 rod	0.099	0.98	0.026	0.027	0.29	0.10	0.05	...	0.02	0.07
	Weld—Mn Va rod	1.04	1.23	0.025	0.024	0.33	0.08	0.05	...	0.02	0.12
3	Plate	0.197	0.86	0.032	0.019	0.25	1.84	0.16	...	0.33	...
	Weld	0.142	0.97	0.026	0.022	0.27	1.31	0.10	...	0.35	...
4	Plate	0.116	0.74	0.029	0.019	0.01	1.35	0.01	1.02	0.22	...
	Weld	0.088	0.85	0.022	0.030	0.18	0.95	0.04	1.28	0.43	...

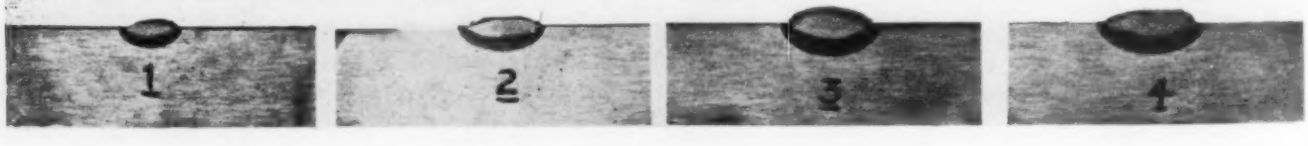
Weld Procedure

Steels 1–4 were welded as follows: (all 1-in. plates)

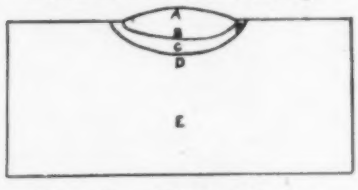
	Amperes	*Volts*	*Speed, in./min.*	*Wire size, in.*	*Flux type*
1st pass	950	36	14	$^7/_{32}$	660 (mineral)
2nd pass	1050	37	12	$^7/_{32}$	660 (mineral)
	Steels 5 and 6—$^3/_4$-in. plates were welded as follows:				
1st pass	750	36	27	$^7/_{32}$	660 (mineral)
2nd pass	1000	36	16	$^7/_{32}$	660 (mineral)

Hand weld practice, weld bead hardness

150 Amp., $^5/_{32}$-in. rod | 200 Amp., $^3/_{16}$-in. rod | 250 Amp., $^1/_4$-in. rod | 300 Amp., $^3/_8$-in. rod



Location of hardness readings



All readings VPN, 10-kg. load

Position hardness	*Steel 1*		*Steel 2*		*Steel 3*		*Steel 4*		*Steel 5,*
	As-welded	*Stress relieved*	*As-welded*	*Stress relieved*	*As-welded*	*Stress relieved*	*As-welded*	*Stress relieved*	*As-welded*
A	164	156	199	188	257	185	219	210	286
B	169	161	195	188	251	185	219	199	345
C	262	214	251	223	435	268	262	219	423
D	178	172	206	175	219	214	182	192	345
E	178	172	227	175	219	214	182	188	313
F	257	210	251	219	424	268	288	227	435

Fig. 3

made on 1/2-in. sections through the welded zone and bent edgewise to the thickness of the plate, show the ductility for the whole welded zone better than the flat bend with the weld bead on the outside of the bend. Either impact or slow bends at room temperature or whatever service temperature is pertinent on such samples would tell us more of the actual worth of such joints than a polished up section, slow bent at room temperatures. The edgeways bending test of the full section through the weld is really much more revealing of the comparative ductility of the various zones in the weld than a test which stresses only one face or the other at a time.

In study of the charted information you will not that Steel 4 is a nickel, copper, molybdenum steel and that Steel 5 is in the quenched and drawn condition before being welded and was not stress relieved after welding. Steels 4, 5 and 6 were considered in this case as materials for unstress-relieved, unfired pressure vessels, too large possibly to stress relieve, so that the plate was treated before welding and welds left in the as-welded condition. Such applications may sometimes be found necessary in large gas storage vessels under pressure at atmospheric or subatmospheric temperatures. It is not expected that such practice could be used at any very elevated temperatures due to possible unstability of the physical properties of the treated steel at such elevated temperatures.

The manganese vanadium steel while approved by the A.S.M.E. Boiler Code Committee for riveted shells has not as yet been approved for welded shells. The results obtained on Steel 2 (Mn Va) would indicate that this material is equal in value as a weldable steel to those analyses already approved.

The experimental weld with the manganese vanadium welding rod was also very successful and the weld produced in this particular instance was somewhat more ductile in bend tests than the weld made with the 0.50% molybdenum rod. Whether the higher manganese in the weld melt might cause more variation in weld analyses and physical properties is open to question.

With regards to the most suitable chemistry for plates

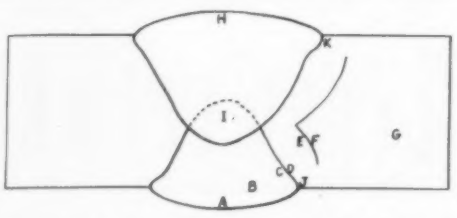


Table 4—Vickers Brinell Hardness in Weld Zone

Automatic Weld

All Readings VPN, 10-kg. Load

Position hardness	Steel 1 As-welded	Steel 1 Stress relieved	Steel 2 As-welded	Steel 2 Stress relieved	Steel 2 As-welded	Steel 2 Stress relieved
					(L-70 electrode)	(Mn Va electrode)
	Steel 3		Steel 4		Steel 5	
A	164	160	192	182	246	
B	216	160	192	178	241	
C	218	202	192	182	241	
D	249	232	192	185	251	
E	249	235	182	192	268	
F	224	212	161	188	257	
G	233	238	164	188	268	
H	178	173	185	188	236	
I	206	193	199	185	241	
J	243	230	192	195	251	
K	221	228	188	192	246	
A	175	169	164	185	178	185
B	182	167	158	182	175	175
C	182	167	164	178	175	203
D	192	169	178	188	192	203
E	185	169	178	178	188	210
F	182	172	164	167	167	164
G	182	182	167	167	167	169
H	192	188	167	188	185	210
I	192	188	161	182	185	185
J	203	175	192	185	192	203
K	203	185	178	188	188	199

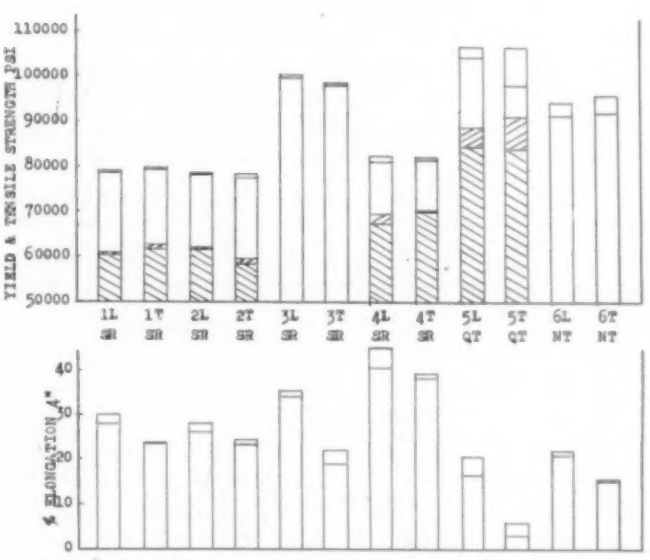


Table 5—Values for Physical Properties, Tensile Tests, on Welded, Stress-Relieved Plates

No.	*Type*	*Condition*	*Direction*	*Yield strength, psi.*	*Tensile strength, psi.*	*Per cent elongation, 4 inches*	*Fracture location*
1	2 1/2% Ni	S.R.	Long.	61,000	79,000	29.0	1/2 in.—W
			Trans.	62,500	79,500	24.0	1/2 in.—W
2	Mn Va	S.R.	Long.	61,500	78,400	27.0	3/4 in.—W
			Trans.	59,000	78,000	24.0	3/4 in.—W
3	Ni Mo	S.R.	Long.	Not defined	99,700	34.5	3/4 in.—W
			Trans.	Not defined	97,700	20.0	3/4 in.—W
4	Ni Cu Mo	S.R.	Long.	68,500	82,000	42.0	1/2 in.—W
			Trans.	70,000	81,800	39.0	1 in.—W
5	Mn Va Ni Mo	Q.T.	Long.	86,000	105,000	16.0	In weld
			Trans.	86,000	104,000	4.5	In weld
6	Mn Va Ni Mo Cu	N.T.	Long.	Not defined	92,900	21.0	1 1/2 in.—W
			Trans.	Not defined	93,400	15.0	1 1/2 in.—W

with high strength, combined with good welding properties, it is our belief that the alloying elements that combine with the ferrite such as nickel, copper, molybdenum and, to within certain limits, manganese and vanadium should be used to their fullest advantage. The carbide-forming elements should be kept low in order to keep down the production of martensite in the heat-affected zone and brittleness in the cast metal beads. The strength of the ferrite should be built up as high as possible and the hardenability kept as low as possible.

We believe that there is still a great deal of experimental work on various combinations of alloys for plate materials that needs to be done and should be done.

ACKNOWLEDGMENTS

The writer wishes to thank the following for furnishing materials and for assistance in making these tests: Carnegie-Illinois Steel Co., Lukens Steel Co., Vanadium Corp. of America, International Nickel Co., Climax Molybdenum Corp. and Lincoln Electric Co.

CURRENT WELDING LITERATURE

Airplane Propellers, Manufacture. Arc-Welded Propeller Hubs Reduce Cost-Weight, J. D. Waugh. Soc. Automotive Engrs.—J., vol. 56, no. 7 (July 1948), pp. 33–39.

Automobile Manufacture. Nash Prepares for 1949 Production, J. Geschelin. Automotive Industries, vol. 99, no. 2 (July 15, 1948), pp. 32–33, 90.

Bath Tubs, Manufacture. Simple Spot Welding Equipment Assembles Bath Tubs. Steel Processing, vol. 34, no. 6 (June 1948), pp. 304–305.

Brazing, Electric. Designing for Silver Brazing by Induction Heating, F. W. Curtis. Product Eng., vol. 19, no. 8 (Aug. 1948), pp. 109–113.

Brazing, Electric. Furnace Brazing Pulleys and Sheaves Cuts Production Costs, T. E. Nelson. Iron Age, vol. 162, no. 10 (Sept. 2, 1948), pp. 92–94.

Buildings, Earthquake Resistance. Seismic Factors Control Design of Ten-Story, Steel-Frame Building, D. L. Narver. Eng. News-Rec., vol. 141, no. 10 (Sept. 2, 1948), pp. 81–82.

Car Building. Advanced Machining and Welding Methods in Car-Building Shop. Machy. (N. Y.), vol. 55, no. 1 (Sept. 1948), pp. 163–165.

Electric Coils, Connections. Copper-Aluminum Joints and Combination Materials Made by Upset Welding, R. T. Gillette. Matls. & Methods, vol. 28, no. 1 (July 1948), pp. 70–73.

Electric Welding, Arc, Submerged Melt. Manual Hidden Arc Welding Increases Welding Speeds, R. Zeh. Steel Processing, vol. 34, no. 7 (July 1948), pp. 358–359.

Electron Tubes, Manufacture. Dissimilar Metals Joined by Step Brazing Methods, I. S. Goodman. Matls. & Methods, vol. 28, no. 2 (Aug. 1948), pp. 64–67.

Furnaces. Heating Metals by Induction and High-Speed Gas Methods, H. R. Clauser. Matls. & Methods, vol. 28, no. 1 (July 1948), pp. 55–59.

Hoists. Welded Frame for 150 Hp, 3-Drum Hoist, L. O. Mellor. Mech. World, vol. 124, no. 3214 (Aug. 20, 1948), pp. 199–200.

Hydraulic Turbines. Repairs Hydro Adjustable Blade Turbines by Welding, J. B. Justin and E. T. Davis. Am. Soc. Mech. Engrs.—Advance Paper, no. 48-F-1 for meeting (Sept. 7–9, 1948), 13 pp., 19 supp. sheets.

Hydroelectric Power Plants, New Zealand. Canterbury's Contributions Towards Karapiro, J. Forrester. New Zealand Eng., vol. 3, no. 5 (May 10, 1948), pp. 481–486.

Jigs and Fixtures. Precision Welding Jigs Simplify Stove Assembly, W. Rudolph. Am. Mach., vol. 92, no. 14 (July 1, 1948), pp. 82–84.

Joints. Survey of Established Processes for Jointing of Metals, D. F. Hewitt. Sheet Metal Industries, vol. 25, no. 250 (Feb. 1948), pp. 363–366, 372; no. 252 (Apr.), pp. 771–776, 782; no. 253 (May), pp. 991–994, 1004; no. 254 (June), pp. 1205–1212; no. 255 (July), pp. 1399–1400.

Locomotives, Mine, Maintenance and Repair. More From Wheels and Axles, F. W. Richart. Coal Age, vol. 53, no. 8 (Aug. 1948), pp. 105–107.

Machinery, Maintenance and Repair. Some Aspects of Welding Repairs, J. K. Johannesen. Shipbldg. & Shipg. Rec., vol. 72, no. 1 (July 1948), pp. 12–13.

Magnesium Alloy Scrap, A. G. Arend. Metallurgia, vol. 38, no. 225 (July 1948), pp. 173.

Metals. Hard Facing. Hard Surfacing with High Frequency Currents, E. M. Kouzmak and A. I. Kourdin. Engrs.' Digest (American Edition), vol. 5, no. 6 (Aug. 1948), pp. 279–280, also Engrs.' Digest (British Edition), vol. 9, no. 8 (Aug. 1948), pp. 258–260.

Natural Gas Pipe Lines, Construction. Texas-California Pipeline Project Complete Over Desert and Mountains. Western Construction News, vol. 23, no. 7 (July 1948), pp. 92–94.

Pipe Aluminum. Welding Aluminum Pipe, J. D. Mattimore. Heating, Piping & Air Conditioning Contractors Nat. Assn.—Official Bul., vol. 55, no. 8 (Aug. 1948), pp. 53–55; (discussion), p. 56.

Pressure Vessels. Twenty-Four Layer Welds Used in Fabricating Propane Decarbonizing Towers. Steel, vol. 123, no. 8 (Aug. 23, 1948), p. 96.

Pressure, Welding. Cold Welding. Automobile Engr., vol. 38, no. 503 (July 1948), pp. 277–278.

Research, Welding. British Welding Research Association. Engineer, vol. 185, no. 4821 (June 19, 1948), pp. 589–590.

Roofs, Corrugated Metal. Welded Studs Cut Costs and Speed Work on Corrugated Metal Roofing Job, R. C. Friedly. Eng. News-Rec., vol. 141, no. 6 (Aug. 5, 1948), pp. 88–89.

Sheet Metal Working, Stamping. Metal Stampings for Ordnance Held to be Answer to Many Needs of Armed Forces. H. C. Wolf. Steel, vol. 123, no. 10 (Sept. 6, 1948), pp. 120, 140.

Steam Power Plants, High Pressure, Los Angeles, Calif. Welding Saves Million Dollars Year at Harbor Steam Plant, C. N. Barlow. Power, vol. 92, no. 8 (Aug. 1948), pp. 459–461.

Steel Plates, Metal Clad. Diversified Applications of Stainless Clad Steel, L. W. Townsend. Steel, vol. 123, no. 10 (Sept. 6, 1948), pp. 95–96, 124, 126.

Steel. Effect of Welding and Local Heating on Residual Stress and Dimensional Changes in Steel, L. C. Bibber. Mar. Eng. & Shipg. Rev., vol. 53, no. 8 (Aug. 1948), pp. 61–63.

Thermit Welding. Welding Screw Shafts to Castings, P. H. Setzler. Iron Age, vol. 162, no. 9 (Aug. 26, 1948), pp. 93–94.

Welding. Choosing Correct Metals—Joining Method, J. W. Kehoe. Machy. (N. Y.), vol. 55, no. 1 (Sept. 1948), pp. 185–188.

Welds. Defects in Aluminum Alloy Spot-Welds, C. R. Dixon. Am. Mach., vol 92, no. 13 (June 17, 1948), pp. 98–101.

Welds, X-ray Analysis. Interpretation of Weld Radiographs. Mech. World, vol. 123, no. 3206 (June 25, 1948), pp. 741–744.

Welds, X-ray Analysis. Shipbuilding Radiography, L. Mullins. Instn. Engrs. & Shipbldrs. in Scotland—Trans., vol. 91, pt. 7 (July 1948), pp. 362–403; (discussion), pp. 404–424

The Stability of Oxyacetylene Flames

A review of the combustion of oxyacetylene mixtures, covering such topics as normal flame propagation, flame velocities, detonation waves, and flame characteristics is followed by discussion of stability of oxyacetylene flames and control of backfire and flashback

by Lewis D. Conta

FOR many years, research workers have been investigating the phenomena of combustion, flame propagation and stationary flames in an effort to improve their ability to use flames in industry. The increased use of gaseous fuel in recent years and the problems that have risen in gas turbine and jet propulsion applications have served to accelerate research of this type. Although little of this work has been done with oxyacetylene mixtures, our fundamental knowledge has reached a point where it is now possible to obtain a reasonably satisfactory picture of the mechanics of the oxyacetylene flame and its relation to flame stability. It is the purpose of this paper to present to members of the WELDING SOCIETY some of the results of these researches, and the resulting concept of flame mechanics. It is intended that this paper shall serve as a background for future reports on the results of research projects that are now in progress in our laboratory.

FLAME PROPAGATION

If a suitable mixture of gases contained in a tube is ignited at some point, a flame originating at the point of ignition will travel along the tube, burning the mixture as it passes. Although many investigators have studied this phenomenon, the details of the mechanism governing flame propagation are still not fully known. Photographic evidence indicates that the flame exists in the form of a narrow reaction zone which advances into the unburned gas, leaving burned products behind it. It is clear that, in order to advance, the flame must somehow bring the fresh gas just ahead of it up to the point of burning. This is done by heat transmission from the burning zone into the unburned gas, and by the diffusion into the unburned gas of active atoms and radicals which act as chain carriers and inaugurate combustion in the fresh gas. Recent work by Tannford and Pease[1] has indicated that diffusion plays a more important part than heat transmission and that hydrogen radicals are the most active carriers of the reaction.

The velocity with which the flame travels down the tube depends not only on the nature and condition of the gas, but also on flow conditions and on the geometry of the experimental setup. In order to eliminate the effects of flow and geometry, and to study something more fundamental than the speed of the flame in the tube, it is customary to define a term for which the name transformation velocity is gaining in popularity. Transformation velocity is the velocity at which the flame moves perpendicular to its surface into the stationary fresh gas. Some of the other terms in common use for this quantity are flame speed, burning velocity, normal velocity, fundamental velocity and ignition velocity. By specifying that the gas be cold and stationary and that the flame move perpendicular to its surface, the variables influenced by the particular arrangement of equipment are eliminated and only those variables directly related to the nature or condition of the gas remain. It thus becomes possible to study the effect of the gas composition, temperature and pressure on the speed at which a flame will travel through the gas. Techniques involving tubes, Bunsen burners, soap bubbles and bombs[2] have been used to measure transformation velocities for various gas mixtures, and many data of this type are available. These data show that for practically all gases, including oxyacetylene, the maximum velocity is obtained for mixtures which are near the stoichiometric ratio but slightly on the rich side of it. Since the stoichiometric mixture of oxygen-acetylene contains 28½% acetylene, the neutral or one-to-one ratio commonly used for welding and cutting is not the most rapid burning mixture. Lean or oxidizing mixtures result in a considerably

Lewis D. Conta is Research and Development Engineer with the Apparatus Research Division, The Air Reduction Research Laboratories, Murray Hill, N. J.

This paper was presented at the twenty-ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

higher flame speed. When compared with combustible mixtures of other fuel gases, the transformation velocity of oxyacetylene is found to be very high, a fact which, as will be brought out below, accounts for the stability problems which are encountered with this fuel.

In addition to normal flame propagation by the heat transmission and diffusion mechanisms mentioned above, a flame may travel through a tube as a detonation wave at velocities many times as high as those normally measured. Detonation waves are always associated with hydrodynamic shock waves which travel at high speeds through the gas. When such a wave travels through a combustible mixture, it is possible for the flame front to couple itself to the shock wave and be carried along at the same high speed. The shock wave which carries the flame front may originate in some local disturbance such as an explosion, or it may be produced by the flame itself. In the latter case, the flame speed will accelerate from its normal value up to the high detonation velocity as the shock wave develops. For a neutral oxyacetylene mixture, the transformation velocity is around 10 ft. per second, while the detonation velocity is approximately 10,000 ft. per second, or one thousand times as fast.

If the gas flow in the tube is turbulent rather than laminar, the increased area of the flame caused by the turbulence results in a velocity of flame travel down the tube which may greatly exceed the transformation velocity. Thus the actual speed at which a flame travels through a tube may vary from fairly low velocities up to the much higher velocities associated with turbulent flow and finally, if conditions are right, the flame may proceed as a detonation wave at the extreme velocities associated with such waves.

In most technical applications of flames for heating purposes, the object is not to permit a flame to travel through a volume of mixed gas, but rather to produce a stationary flame that can be controlled and directed as needed. Basically such a stationary flame is produced by causing the gas to flow toward the flame. If the gas velocity just equals the flame velocity, then the flame should remain stationary. Actually, as will be explained below, the production of a stationary flame is not as simple as this. It is, for example, difficult to hold a flame stationary in a tube without the use of some special flame-holding device. At the exit from a tube, however, conditions are favorable for establishing a balance between gas and flame velocities, and stationary flames are easily established.

STATIONARY BURNER FLAMES

In order to discuss burner flames more fully, it is necessary to consider the way in which both gas velocity and transformation velocity vary with position in the tube.

It has been well established, both theoretically and experimentally, that for streamlined or laminar flow the velocity of a gas flowing in a tube varies from zero

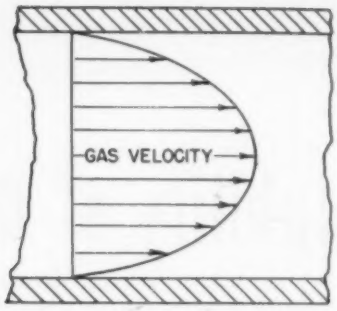


Fig. 1 Variation of gas velocity with position in tube laminar flow

at the wall to a maximum velocity on the tube axis, the actual velocity traverse being parabolic (Fig. 1). Lewis and von Elbe[3] made an experimental verification of this fact, and showed, in addition, that the same parabolic velocity distribution is maintained even after the gas has left the tube and is flowing as a free stream. Above the tube, however, another factor enters which plays an important part in the stationary flame mechanism. As the stream leaves the tube and moves through the surrounding atmosphere, diffusion of combustible gas out into the atmosphere and of atmospheric air into the gas stream results in the flowing stream being surrounded by a mixing layer. In this layer the proportion of fuel gas drops from its value in the undiluted stream to zero at the outer edge of the mixing zone. Thus, we see that at its boundary the gas stream is stationary or moving very slowly, and that above the burner it is enclosed in a layer of variable composition.

Turning now to a consideration of transformation velocity, we find two important factors playing a part. Inside the tube, the cold walls exert a detrimental influence on the combustion reaction, resulting in a substantially zero transformation velocity over a small distance out from the wall. Beyond this quenching distance the transformation velocity rises rapidly to its normal value. The actual width of the quenching zone depends on the composition, temperature and pressure of the gas, and on the temperature of the wall. For fast-burning mixtures such as oxyacetylene, its value is only a few thousandths of an inch. As the gases leave the tube and enter the free stream above the burner, the quenching action of the cold wall is lost, and the transformation velocity at the boundary rises rapidly. Very soon, however, the effect of dilution in the mixing zone becomes important, and the transformation velocity at the boundary again drops, the decrease becoming greater as the distance from the burner tip is increased. These variations in velocity are shown in Fig. 2, after the method used by Lewis and von Elbe.[3] Curve *a*, taken within the tube, shows that the transformation velocity is zero over a certain dead space, and then rises rapidly to its normal value for the gas mixture as the distance from the wall is increased. Curves *b* and *c* show the region of zero flame velocity diminishing as the wall effect is lost above the tube,

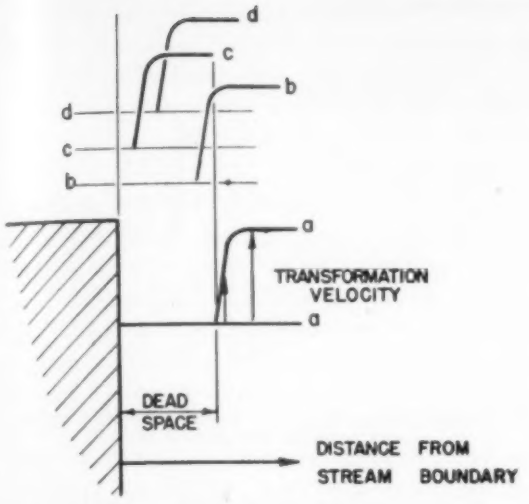


Fig. 2 Transformation velocity curves near tube wall

while in Curve *d* the dilution effect of the mixing zone has caused the active region to recede again from the stream boundary. In drawing these curves, the effect of expansion of the gas stream above the nozzle has been neglected.

By plotting transformation velocity and gas velocity curves on the same axis, the relationship necessary for a stable stationary flame may be shown.[3] In Fig. 3 these curves are plotted for the region near the wall within the tube. Curves *r*, *s*, and *t* show the variation in gas velocity with distance from the wall for high, medium and low flows. Curve *a* is the transformation velocity. For high flows (Curve *r*) the gas velocity is everywhere higher than the flame velocity and the flame will be carried along by the stream and blown out of the tube. At a low velocity (Curve *t*) there exists a region over which the transformation velocity exceeds the gas velocity, and the flame will therefore strike back through the tube. For the flow rate corresponding to Curve *s*, the gas velocity is high enough everywhere to prevent the flame from traveling upstream. At one point (the point of tangency of the curves) the two velocities are equal, and the flame at this point will be stationary. This small stationary

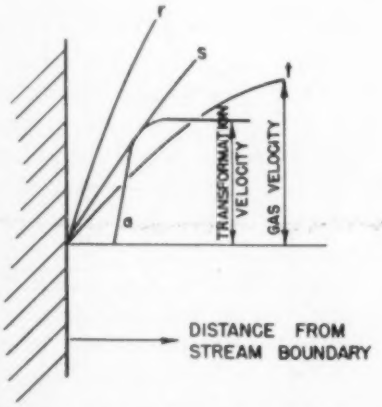


Fig. 3 Conditions for stability inside tube

flame element can then act as a pilot light and maintain combustion over the whole stream. This situation within the tube represents, however, an unstable equilibrium which cannot easily be maintained. Any slight change in conditions will cause the flame either to strike back or to blow out of the tube.

Conditions outside of the tube are shown in Fig. 4. Here the transformation curves *a*, *b*, and *c* of Fig. 2 are replotted, but with all the curves moved down to the same *x* axis. The curves still represent conditions at various levels above the burner. Curve *r* represents the gas velocity for a given total gas flow. It can be seen that inside the burner (Curve *a*) the gas velocity everywhere exceeds the flame velocity and the flame will blow out of the tube. At the level represented by Curve *c*, there are places where the flame velocity is greater than the gas velocity and the flame will move back toward the tube. At level *b*, the necessary condition for equilibrium exists and a

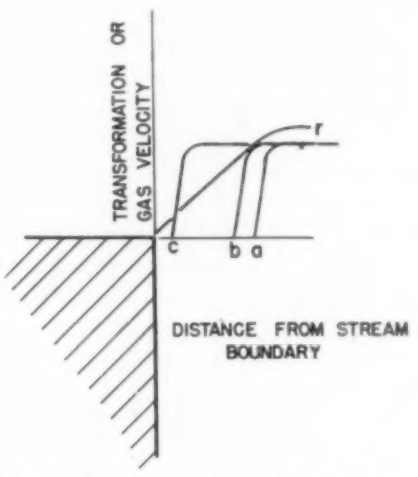


Fig. 4 Conditions for stability above tube

stable flame is formed. Furthermore, it is evident that this is a position of stable equilibrium, for any motion of the flame cone away from the burner, or back toward the tip, will produce conditions that cause the cone to return to its stable height. Thus, it is evident that the flame cone will not be seated on the burner lip, but will rise above the lip until that level is found where the transformation velocity curve is tangent to the gas velocity curve.

If Curve *a* represents conditions inside the tube, and Curve *c* is the transformation curve which is nearest to the stream boundary (at higher levels the diffusion effect moves the curve back toward the tube axis), then the conditions of tangency to these curves represent the extreme limits of operation of the tip (Fig. 5). For total gas flows which yield velocity curves below *s*, the flame will run back through the tube; while for flows that cause velocities above *u*, the flame will blow completely away from the burner. These flows then represent the upper and lower limits for stable operation of the tip.

The effect of some of the operating variables on these

flow limits can now be visualized. If the gas ratio is changed from neutral to oxidizing, the transformation velocity will increase as explained above, and Curve *s* will have to rise to remain tangent. Thus, a higher gas velocity, and therefore higher flow, is required to prevent backfire under oxidizing than under neutral conditions. Conversely, a carburizing flame will be stable at lower flows than a neutral flame.

Overheating a tip will likewise cause the transformation velocity to increase and the dead space to decrease, thus raising the critical velocity necessary to prevent backfire. However, heating the tip also expands the gases, thereby increasing the velocity automatically. Which effect is more important depends on the particular setup involved. Often such heating will cause backfire, but it is also possible under some circumstances to increase the gas velocity sufficiently by heating to cause the flame to blow away.

Having established the conditions for stability of a burner flame, attention will now be directed to a brief

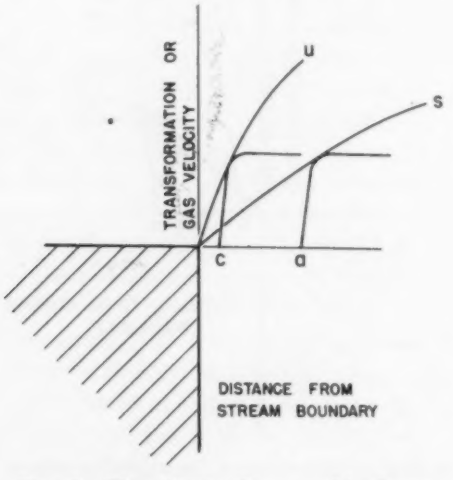


Fig. 5 Flow limits for a stable flame

consideration of the characteristics of the cone itself. As was pointed out above, a stable cone results when, over some small region near the rim, the transformation and gas velocities are equal. Over the remainder of the tube area, the gas velocity exceeds the flame velocity, consequently a plane flame surface is not possible. In order to produce a stable condition, the flame must establish itself at an angle with the stream flow such that the transformation velocity is just equal to the component of the gas velocity perpendicular to the flame surface. It can be shown that, if a constant gas velocity over the cross section of the tube, and a constant transformation velocity are assumed, the stable form of the flame will be that of an erect right-angled cone. Figure 6 shows the relationships involved. Since neither of these assumptions is strictly true, the actual flame shape is only roughly conical, with major deviations from a true cone appearing at the base of the flame and at the tip. More exact studies of the actual flame shape have been made by Michelson,[4] Mache[5] and others, but since this work has little application to the stability problem, it will not be considered further

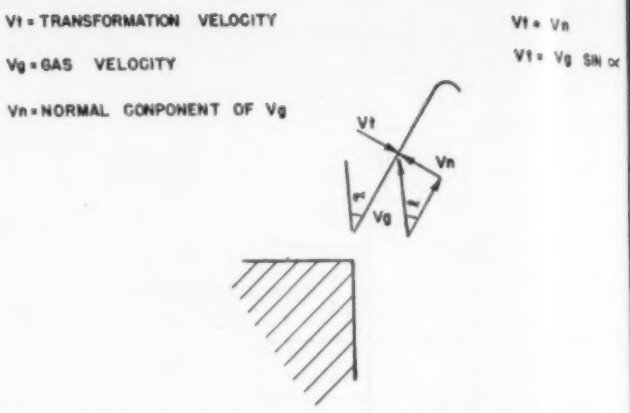


Fig. 6 Relationship between transformation velocity and gas velocity for stable cone

here. If the gas flow is turbulent rather than laminar, the flame cone loses its sharpness and becomes more diffuse with a broader top. The actual shape and length of the cone are also influenced by the shape of the tip orifice. A properly designed converging approach passage, for example, produces a longer cone than a straight tube. As was discussed above, the cone does not touch the metal wall of the tip, but remains suspended a very short distance above the rim, this distance varying with the gas velocity and composition and with the wall temperatures. In addition to this effect, the flame also overhangs the rim of the burner by a small amount (Fig. 7). This overhang is due to the expansion of the gas stream as it leaves the nozzle, thus carrying combustible mixture out over the burner rim. The expansion of the gas is caused largely by the back pressure due to the acceleration of the burned gases through the flame surface.

If the combustible mixture fed to the flame is of stoichiometric composition, combustion will be substantially completed in a thin conical flame surface. Except for some after-burning due to imperfect mixing and to an equilibrium shift as the temperature drops, there will be no zone of secondary reaction. If a richer mixture is burned, however, the products of combustion of the mixture supplied through the burner will themselves be combustible and will burn with oxygen from the atmosphere in an outer or secondary cone. In a neutral oxyacetylene flame for example, the primary reaction of equal volumes of oxygen and acetylene will yield combustion products made up of carbon monoxide

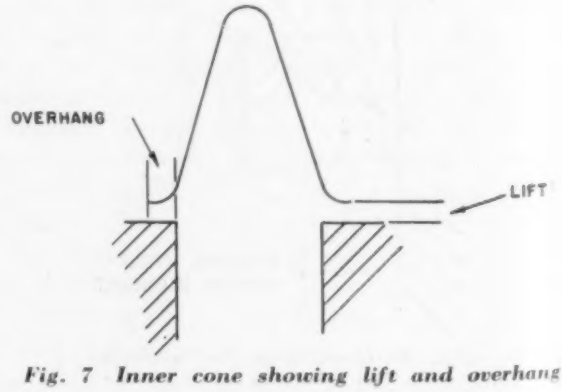


Fig. 7 Inner cone showing lift and overhang

and hydrogen according to the equation $C_2H_2 + O_2 \rightarrow 2CO + H_2$. The first reaction takes place in the inner or blue cone, while the carbon monoxide and hydrogen combine with atmospheric oxygen in the secondary envelope. Oxygen for combustion in the secondary envelope must be supplied from the atmosphere by diffusion and turbulent mixing, processes which are relatively slow compared with the rate of combustion in the inner cone. Consequently, the outer region is large and diffuse and of relatively low temperature, while the inner cone is small, sharply defined and extremely hot. As the amount of oxygen in the mixture is increased above the neutral one-to-one ratio, the combustion is more nearly completed in the primary zone, and the temperature of the inner cone increases. Eventually, of course, the mixture becomes excessively lean and the flame temperature will again drop. The peak temperature is produced by a mixture having an oxygen-acetylene ratio of approximately 1.5 to 1. If more acetylene than the normal one-to-one ratio is used a third cone or "acetylene feather" is produced between the inner cone and outer envelope. The appearance and characteristics of these oxidizing and carburizing flame are so well known to those familiar with oxyacetylene equipment that no attempt will be made to describe them more completely.

THE STABILITY OF BURNER FLAMES

A gas burner is said to be unstable if it can easily be caused to backfire or flashback, or if the flame blows away readily. The terms backfire, flashback and blow-away may be defined as follows:

A backfire is a momentary recession of the flame into the torch followed by immediate reappearance or complete extinguishment.

A flashback is a recession of the flame into the torch followed by continued burning within the torch.

Blow-away is the carrying away of the flame from the burner by an excessively high gas velocity.

These terms are defined here in accordance with the *Welding Handbook*, and with common practice in the welding industry. It may be well to point out that among other workers in the field of combustion, the word "flashback" is used as we use backfire, and little or no attempt is made to distinguish between a momentary recession of the flame and continued burning within the torch. Some people in our own industry feel that it would be better to use flashback to mean, as the work implies, a temporary flash into the torch, and to use backfire, or perhaps some new word such as burnback, to describe a continued burning within the torch. By so doing, our own definitions would be more nearly in agreement with those found in the general literature of combustion. Such a change seems worth while, and might well be considered by the proper committee of the Society. In this paper, however, the terms will be used as defined above.

The mechanism of backfire has already been discussed. If at any point in the stream the transformation velocity exceeds the gas velocity, the flame can run upstream and enter the torch. Since the gas passage upstream of the tip is usually larger in diameter than the tip itself and consequently has a lower velocity of gas flow through it, the flame once it has entered the torch will travel rapidly back to the mixer. This backfire or popping is a fairly common phenomenon in oxyacetylene torches and is well known to all users of such equipment. In testing a tip for backfire stability, the object is generally to determine the limiting flow below which backfire appears. This may be done by presetting the flow of oxygen and acetylene and observing whether the tip backfires or burns normally on ignition, or by establishing a normal flame and then gradually reducing the flow until backfire occurs. If the first method is used, the back-pressure set up when ignition takes place reduces the gas flow and causes backfire at higher flows than are found if the second method is employed. The latter method is also open to some question due to the appearance of tilted flames as the flow is reduced. From a practical standpoint, however, either method will yield useful and generally reproducible results.

Since the tendency for a tip to backfire depends on both gas velocity and gas ratio, it is necessary to explore carefully a wide range of flows and gas ratios, and to check for backfire at each setting. The results of such a test are generally expressed by means of a backfire curve such as is shown in Fig. 8. The area under the backfire curve on this plot represents the locus of points at which the burner will backfire. Any corresponding values of velocity and acetylene percentage which plot as a point outside the dome represent operating conditions that are stable against backfire. The curve thus shows the region that must be avoided in the operation of the tip in order to avoid spontaneous backfire. It is clear from the curve that the velocity which must be maintained to prevent backfire is very much higher for oxidizing than for neutral or carburizing flames. Hence if a burner tends to be unstable, oxidizing conditions must be avoided. Oxidizing flames are, on the other

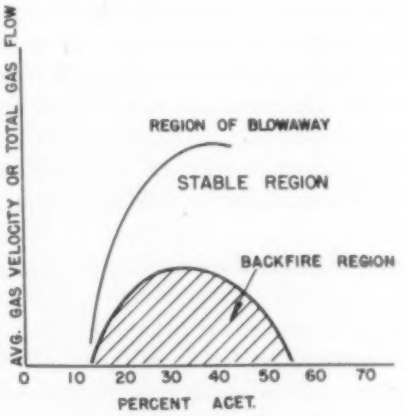


Fig. 8 Backfire and blowaway curves

hand, hotter than neutral flames and, unless undesirable for metallurgical reasons, are often used. For this reason, a degree of inherent stability which is sufficiently high to permit the use of excess oxygen flames is highly desirable.

At the same time that data for the backfire curve are being taken, the blow-away curve can also be established. By increasing the flow at each gas ratio until the flame blows away from the burner face, the data necessary to plot the blow-away curve shown on Fig. 8 are obtained. The condition necessary to cause blow-away is, as described above, that the gas velocity must exceed the transformation velocity everywhere in the stream.

Since the transformation velocity and gas velocity are both influenced by the wall, it is evident that the backfire and blow-away curves will be affected by the size and shape of the burner nozzle. In general, as the diameter of the hole increases, the backfire curve becomes higher and broader; that is, the region of instability increases. The blow-away curve is also raised, however, by an increase in diameter, so that the stable region between the backfire and blow-away curves is not greatly affected. Lewis and von Elbe[3] showed that if these curves for straight tubes are plotted using velocity gradient at the wall instead of velocity as one of the coordinates, the curves for all tube diameters within a certain range coincide. Bollinger and Williams[6] confirmed this fact for the blow-away curves and found that it held also for turbulent flows. Little of this work has been done with oxyacetylene flames, however, and no such correlation has been found for the different shaped orifices found in oxyacetylene equipment. For these reasons, it seems safer, for the present at least, to establish separate stability curves for each orifice size and shape encountered.

It should be emphasized here that the backfires which occur for operating conditions represented by points under the backfire dome are spontaneous backfires. That is, they occur due to insufficient flow alone and without the help of any external disturbing influence. It is proposed that the terms "spontaneous" and "induced backfire" be used to distinguish between backfires caused by insufficient flow and those caused by some disturbance. Although the basic cause is undoubtedly the same in each case, the distinction as to immediate cause is useful in backfire testing. Spontaneous backfires, for example, are only possible under the backfire dome, while induced backfires can be produced at any gas flow or mixture ratio. The types of external factors that cause induced backfire will be discussed later.

In many respects, flashback is a more serious cause of trouble than backfire. If a welding torch pops and the flame is either extinguished or relights in its normal position, no permanent harm is done. If the flame continues to burn inside, however, the extreme heat may damage the equipment. This is particularly true of large automatic equipment where the operator may not be aware immediately that anything has gone wrong. The exact mechanism that causes a backfire to develop into a flashback is not known. It appears to be related to the type of tip, to the characteristic of the mixed-gas passages and to the design of the actual mixer. This problem is under investigation in our laboratories at the present time and will be discussed fully in a future paper.

The importance of backfire in this problem is due to the fact that a flashback always has its origin in a backfire. If backfires could be entirely eliminated, flashback would no longer be a problem. While it is difficult or impossible to completely eliminate backfires in conventional oxyacetylene equipment, they can be minimized by care in the design and operation of such equipment. Most of the remainder of this paper will deal with the control of backfires by such means.

CONTROL OF BURNER INSTABILITY

The backfire of oxyacetylene burners under actual operating conditions may be attributed to several possible causes. These causes are listed below, and a brief discussion of their control is given.

Inherent Flame Stability

In order to avoid backfires, it is obviously necessary to operate the burner within its stable range. That is, operating conditions which represent points under the backfire curve or above the blow-away curve (Fig. 8) must be avoided. If a tip is designed for fixed operating conditions, avoiding the unstable areas is not a serious problem. If, on the other hand, a single burner must be able to burn with either a hard high velocity flame for heating or a soft low velocity flame which will not splatter the molten puddle, serious difficulties may be encountered. Since a soft flame is obtained by operating near the backfire dome, and since the operator has no way of knowing how close to the dome his setting is, relatively unstable operating conditions are frequently used. This situation is aggravated when oxidizing flames for rapid heating are desired. Referring again to Fig. 8, it is evident that the stable velocity range is greatly reduced when gas ratios below neutral are employed. Sometimes, on the other hand, carburizing flames are required for extreme protection against oxidation, and under these conditions stability is generally not a serious problem.

If protection against backfire is the most important consideration, then using a small orifice diameter with its associated smaller backfire dome will be advantageous. If the orifice diameter is reduced to approximately twice the dead space, then flame propagation will no longer be possible and the burner should be backfire-proof. The very small dimension necessary to attain this stability with oxyacetylene, however, makes burners designed on this basis of limited useful-

ness. Furthermore, it has been demonstrated in our laboratory that even if the small dimension necessary to prevent flame propagation is used, an explosion outside of the tip can drive the flame back through the orifice and produce a backfire.

In the case of multihole burners, the completeness of mixing of the gases and the uniformity of distribution from hole to hole are factors of great importance. If, for example, one hole is so situated that the gas flow through it is less than through the others, this hole will be operating closer to the backfire dome and will be more subject to backfire. Since in most multihole burners all of the orifices are fed from a common gas chamber, the backfire of a single hole is sufficient to ignite all of the mixed gas and cause a loud explosion. It becomes, therefore, highly important to design the approach and distribution passages in a manner that will insure equal gas flow to all orifices. Examples of situations that may cause difficulty are shown in Fig. 9. In Fig. 9 (*a*), a high gas velocity in the approach passage may result in hole *a* being located in a low-pressure pocket, thus making it more likely to backfire than its neighbors. In the situation shown in Fig. 9 (*b*), two opposing factors must be considered. Due to the normal frictional pressure drop, the static pressure will tend to drop in the direction of flow. At the end of the passage, however, the conversion of kinetic to pressure energy will result in an increase in static pressure. Both of these effects may be reduced in magnitude by increasing the cross-sectional area of the gas passage.

Imperfect mixing has a similar undesirable effect. If the mixture is nonuniform, some flames will be somewhat carburizing, while others are slightly oxidizing. Since the oxidizing flames will be more subject to backfire than those which are neutral, the over-all stability of the burner will be reduced. Good mixing is promoted by properly designed mixers and by gas-passage arrangements which promote turbulence in the region between the mixer and the tip.

Accidental Flow Reductions

Any condition which will reduce the total gas flow or the gas velocity, even momentarily, will serve to promote backfiring. A common cause of such induced backfires is the temporary stoppage of the tip orifice by an obstruction. The stoppage may be caused by purposely hitting the tip with a stick, as is commonly done in tip testing, or by accidentally bumping the lighted tip against the workpiece in welding or cutting. When this happens, the total gas flow, and consequently the gas velocity in the burner passages, is reduced. Although the actual gas velocity through the restricted orifice will be up to or above its normal value, the disturbance caused by the obstruction may permit the flame to enter the tube. Once it is inside where the velocity is below normal, the flame will travel rapidly back to the mixer.

A reduction in flow may also be caused by particles of dirt inside the hoses or torch. These particles may lodge in the mixer or in a restricted gas passage below the mixer, thereby reducing the gas flow to the tip. Since this type of stoppage does not reduce the area of the exit orifice, but does reduce the total gas flow, the exit velocity will drop and a backfire becomes possible. The danger of backfire is increased if the stoppage is in the acetylene instead of the oxygen passage, for such a stoppage will increase the ratio of oxygen to acetylene as well as decreasing the total gas flow. The obvious solution to this difficulty lies in the observance of scrupulous care in the handling of all oxyacetylene equipment. Hoses should be blown out before being used, and torches, mixers and tips should be kept free at all times of particles of dirt, carbon or metal chips.

Variations in gas flow caused by fluctuating line pressures or by poorly designed or improperly operating regulators may also lead to instability, particularly if the equipment is being operated near the backfire dome in order to produce a soft flame. Where several pieces of equipment are being operated from a single gas line, the additional pressure drop created by the turning on of another torch may reduce the pressure sufficiently to cause one of the other torches to backfire. These difficulties may be minimized by avoiding operating conditions which are too close to the unstable region.

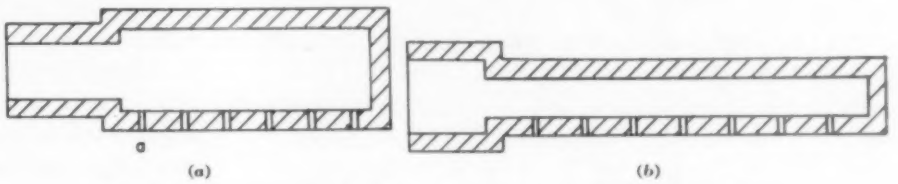


Fig. 9 Gas systems which may cause nonuniform distribution

Overheating of the Burner

Any substantial increase in the temperature of the burner wall will reduce the dead space and thereby increase the area under the backfire dome. Thus, anything that serves to prevent such heating will promote resistance to backfire. Probably radiation from the hot workpiece is the major source of the heat that enters the burner and causes overheating. In order to minimize the possibility of overheating, the burner should be designed with as small an area as possible through which radiant energy from the workpiece and flame can be absorbed, and with a large area available to re-radiate heat to cooler regions away from the flame. In difficult cases a properly designed water-cooling system may be the only solution.

Lighting-Up Procedure

Backfires frequently occur during the process of lighting an oxyacetylene burner. When the gas valves are first turned on, the velocity of flow is low, and, if a

source of ignition is present, the flame may be able to enter the burner. The possibility of a backfire will be greatly reduced if pure acetylene is turned on first and ignited, and the oxygen then turned on. If this procedure is followed the flame will be carburizing, and hence more stable, while the gas flow is building up and will not reach neutral until the flow is up to its normal value. Similarly in shutting down, if the oxygen is turned off first, there is less chance of a backfire occurring.

Another danger associated with lighting up lies in the possibility of forming a combustible mixture in the gas passages upstream of the mixer. Whenever, due to purging or to starting sequence, one gas is turned on before, or without, the other, back flow of this gas through the mixer will produce a combusible mixture in the other supply line. Unless care is exercised this mixture may be ignited and a flashback result. If the mixture burns in the oxygen system the hose may be ignited, while if it burns in the acetylene supply line it may release enough carbon to block seriously the gas system. This danger can be eliminated by always purging the acetylene line last, and then turning the acetylene on first for lighting. If this procedure is followed the mixture will be formed in the oxygen supply passage, and will be gradually fed, without danger, into the acetylene stream when the oxygen valve is opened.

A further powerful measure of protection against danger from mixed gases in the supply lines is afforded by the use of check valves in these lines as near the mixer as possible.

Miscellaneous Sources of Trouble

It is well known by those experienced in oxyacetylene work that various minor disturbances are often the cause of backfiring. Any burr, dent or other imperfection in the shape of the exit orifice may be such a source of trouble. The explanation for this phenomenon probably lies in the turbulence that may be created by the irregularity. Since the flame speed is increased in turbulent flow, the flame may be enabled to strike back through the orifice. Accumulations of slag or other foreign matter can have a similar effect, and may also, by their insulating effect, raise the effective tube wall temperature, thus reducing the dead space and promoting backfire. In cleaning tips with drills or other cleaning devices, extreme care must be exercised to avoid roughening, bell-mouthing or otherwise changing the contour of the orifice.

Flying particles of scale, slag, molten metal or even drops of water can upset a normally stable flame and cause a backfire. The exact mechanism by which these particles effect the flame is not known, and generally little can be done to avoid them. Thus backfires from sources such as these cannot always be avoided. In many applications of oxyacetylene flames, an occasional backfire of this type may not be particularly objectionable, provided that the backfire does not develop into a flashback. The factors that influence the development of a backfire into a flashback are now under investigation, and will be reported upon at a later date.

References

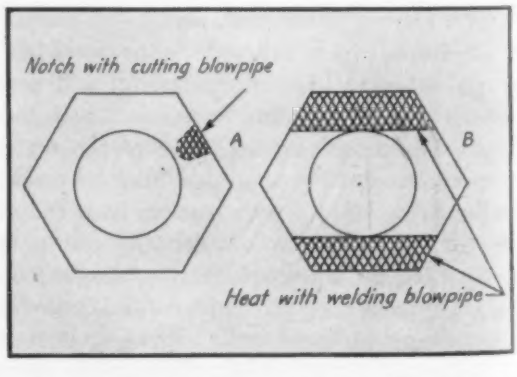
1. Tanford, Charles, and Pease, Robert, "Equilibrium Atom and Free Radical Concentrations in Carbon Monoxide Flames, and Correlation with Burning Velocities," *Jour. Chem. Phys.*, **15** (7), 431–433 (July 1947).
2. For a summary of the experimental methods and results, and for references to the original papers, see Jost, Wilhelm, *Explosion and Combustion Processes in Gases*, McGraw-Hill Book Co., Inc., New York, N. Y. (1946).
3. Lewis, Bernard, and von Elbe, Guenther, "Stability and Structure of Burner Flames," *Jour. Chem. Phys.*, **11** (2), 75–97 (Feb. 1943).
4. Michelson, Wiedemanns, *Ann.*, **37** (1889).
5. Mache, H., *Die Physik der Verbrennungserscheinungen*," Leipzig, 1918.
6. Bollinger, Lowell, and Williams, David, "Experiments on Stability of Bunsen-Burner Flames for Turbulent Flow," N.A.C.A. Tech. Note No. 1234 (June 1947).

Two Ways to Remove Frozen Nuts

by F. C. Giebig

THESE two methods for removing frozen nuts save a lot of time and work. Use your blowpipe whenever bolted parts that are rusted together have to be taken apart. If the nut can be scrapped, cut one side partly through without nicking the bolt, as shown at *A*. Then turn it off the bolt easily with a wrench.

Mr. Giebig is a development engineer with The Linde Air Products Co., New York, N. Y.



When the nut must be saved for further use, use the welding blowpipe. Heat opposite sides to a red heat taking care not to heat the bolt, as shown at *B*. After the nut cools slightly, it will be easy to remove it with a wrench.

Welding the Modern Diesel Locomotive

Welding manifolds, generator adapter cylinder blocks, and frame production methods are described

by H. S. Swan

THE modern Diesel locomotive with its engine is pretty much a welding proposition throughout, from the block through the oil pan base, the generator, the locomotive frame and outside skin, down to many of the small tools.

As may be seen in Fig. 1, the individual weldments, and even the welds themselves, are almost completely obscured on the finished engine. However, Fig. 2 shows a few of the weldments, such as brackets, manifolds, headers, supports, gear casings and the intricate multipipe 16 cylinder exhaust manifold, which are made in the new Small Welded Products Dept. at Schenectady.

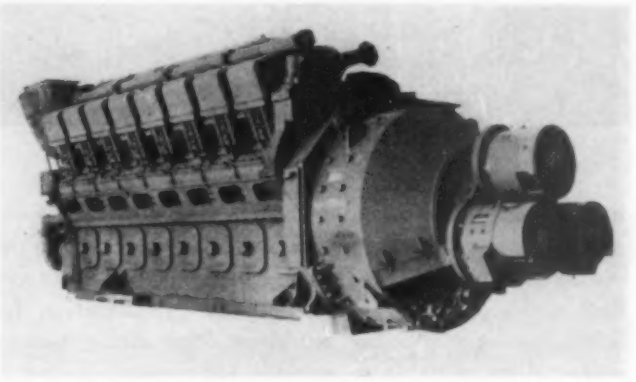


Fig. 1 2000-hp. Diesel locomotive engine

Fig. 2 Diesel engine parts

THE ENGINE

These manifolds operate at a temperature of approximately 1100° F. and are made of light gage 18–8 stainless steel tubing, and in view of the service requirements and the fabrication by welding, we have standardized on S.A.E., Type 347, to minimize carbide precipitation. The basic principle of all weldment fabrication in Schenectady is the use of small preassemblies which are completed as far as possible, followed by a careful check and, in some cases, a preliminary machining before incorporation into the final assembly. The exhaust manifold is no exception. One of the double-sided rotating assembly fixtures for unit preassembly may be seen in Fig. 3. All welding of the manifolds is performed by the electric arc, using Type 2347 electrodes, and the units are placed in service without stress relieving or machining.

One of the most complicated and difficult weldments of the Diesel engine is the generator adapter shown in sample cross sections in Fig. 4. It has turned out to be an economical and happy welding of castings for the heavy bolting lugs to formed plates and tubes into a composite unit of many faces which are machined to extreme accuracy. During the evolution of procedures

Fig. 3 Exhaust manifold fixture

H. S. Swan is Welding Engineer with the American Locomotive Co., Schenectady 5, N. Y.

This paper was presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

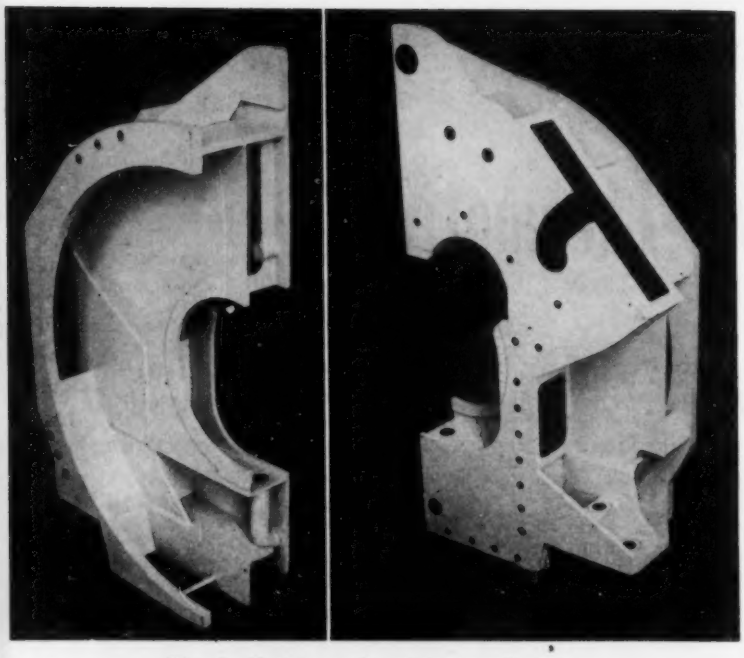


Fig. 4 Sections of generator adapter

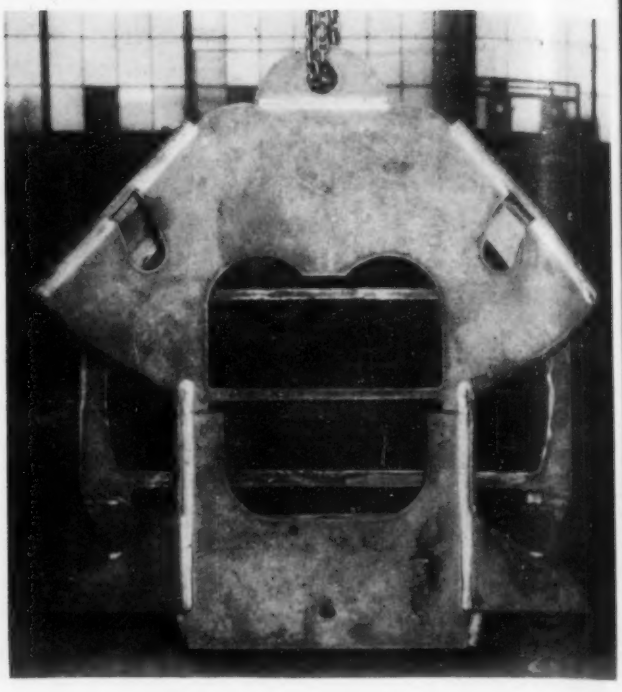


Fig. 6 Generator adapter

for the adapter, we frequently felt the need for the use of an automatic process, such as submerged arc, to decrease the welding time for some of the heavy fillets and butt welds. However, the normal consideration for submerged arc welding envisions long straight-away seams of appreciable magnitude for reasonable use of the process. As shown in Figs. 5 and 6, suitable equipment and fixturing allows efficient use of the process for comparatively short welds, thereby eliminating their back-chipping and decreasing the welding time for them by about 75%.

Probably the most extensive setup for the manufacturing of weldments is at our Auburn plant where we manufacture V-type engine cylinder blocks, as seen in Fig. 7, in addition to some of the older type in-line units for stationary service. Here, three new complete shops have been turned over to the preparation of parts for incorporation into weldments and their welding assembly. The procedures are based upon the use of heavy cast-iron foundations which act as a portable floor plate and which remain attached to the unit throughout its various assembly stages, including final stress relief. This allows a progressive method of fabrication in which individual pieces are added and welded so as to build up the unit, followed by progressive checking and, in some cases, machining before addition of the next part.

In Fig. 8, the first assembly, which includes foundation plates for rails, forged bearing saddles and the spline or backbone of the engine, may be seen as it is assembled on the cast-iron foundation. Positioners are used extensively so that as much of the welding as possible may be performed in the flat or horizontal position with A.W.S. Class E-6020 electrodes, thereby materially increasing the quality and at the same time decreasing over-all cost.

After some of the long plates have been added, their connections, which are long, straight, continuous seams, are welded by the automatic submerged arc process, as

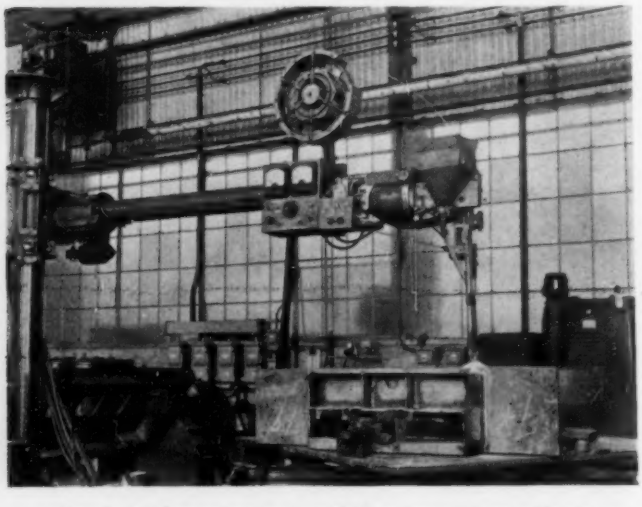


Fig. 5 Submerged arc-welding generator adapter

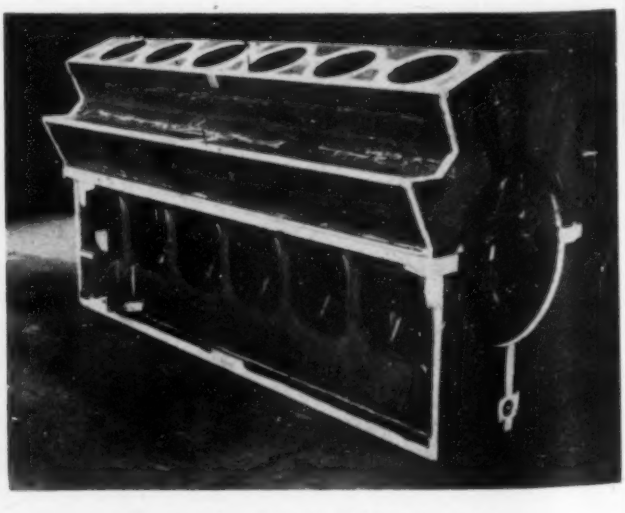


Fig. 7 Diesel engine V block and base

shown in Fig. 9. In some cases, such as shown here, the weld is a combination manual-automatic arrangement where the first side is welded in close quarters by hand and then completed by the submerged arc process. This not only saves welding time but also eliminates the need for back-chipping on this important joint.

After all of the longitudinal members have been completely welded, the block is turned on end and all of the small transverse stiffener webs are fitted and welded

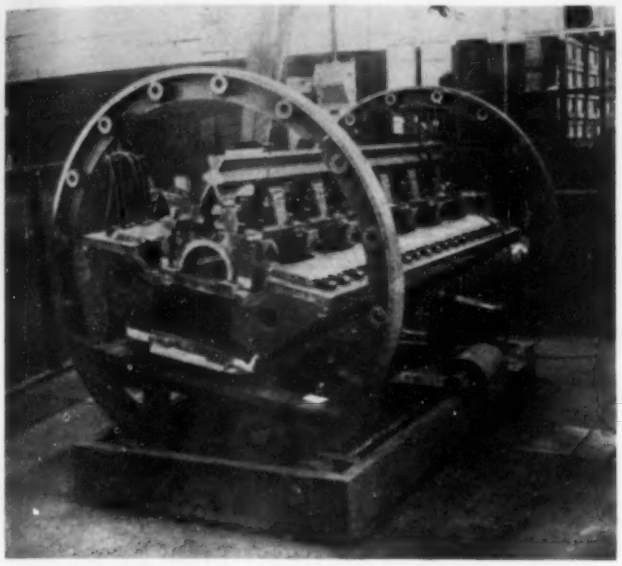


Fig. 8 First assembly

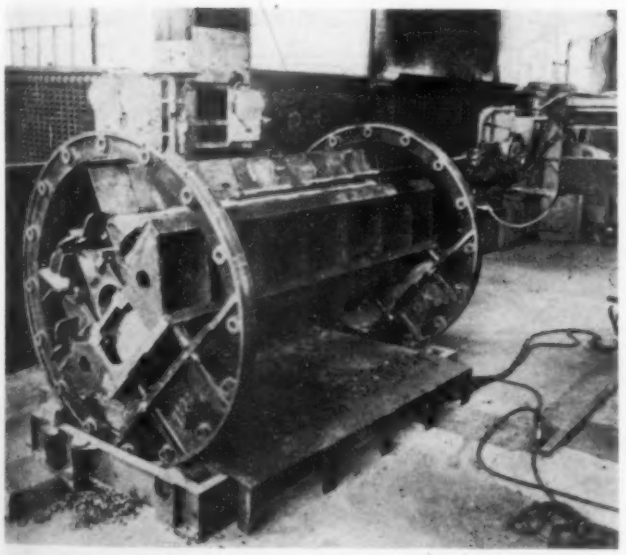


Fig. 9 Submerged arc-welding engine block

with ordinary double fillet T-welds. The block is then ready for its "closing-in" end plates. During assembly, each of the longitudinal members was located according to its own transverse center line with little regard for alignment at the ends. As shown in Fig. 10, both ends of all longitudinal members are machined to close tolerances; then the end plates are accurately fitted and welded. The finished block, shown in Fig. 11, is carefully stress relieved and then machined on the bottom,

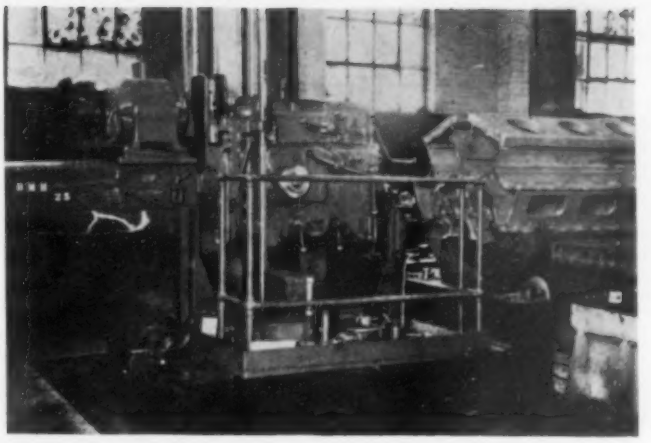


Fig. 10 Machining block ends

top, sides, ends and internally to tolerances of a few ten thousandths of an inch.

PRODUCTION AIDS

With the advent of extensive welded construction, and items known as weldments, it became increasingly apparent that new drawing room procedures and techniques would be required. An example of some of this progress is shown in Fig. 12, which is the detail drawing for the cylinder sidewall of our V-block. It may be seen that the dimensions are shown from a center line both ways toward the ends and, in addition to the fairly common allowance for machining, we have provided specific allowances for shrinkage during welding. An explanation of the shrinkage allowances and, in many

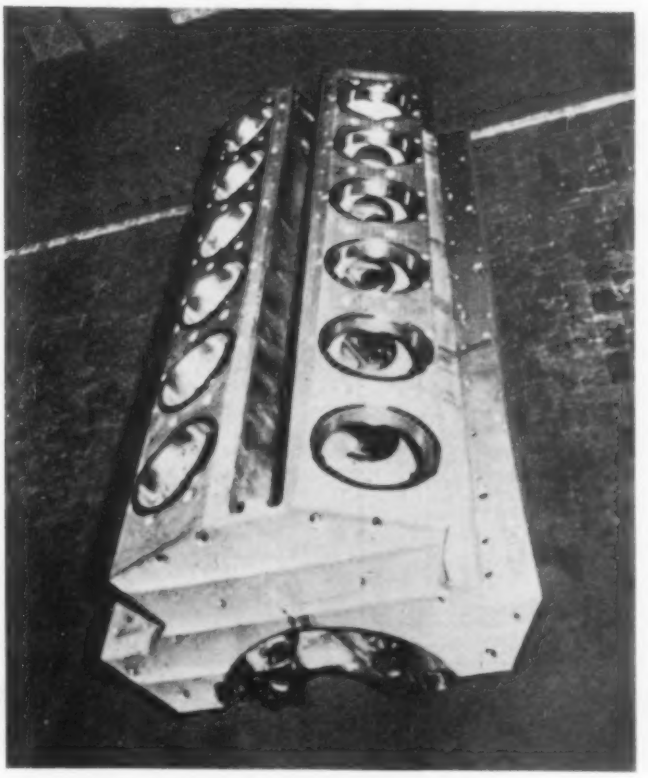


Fig. 11 Finished V block

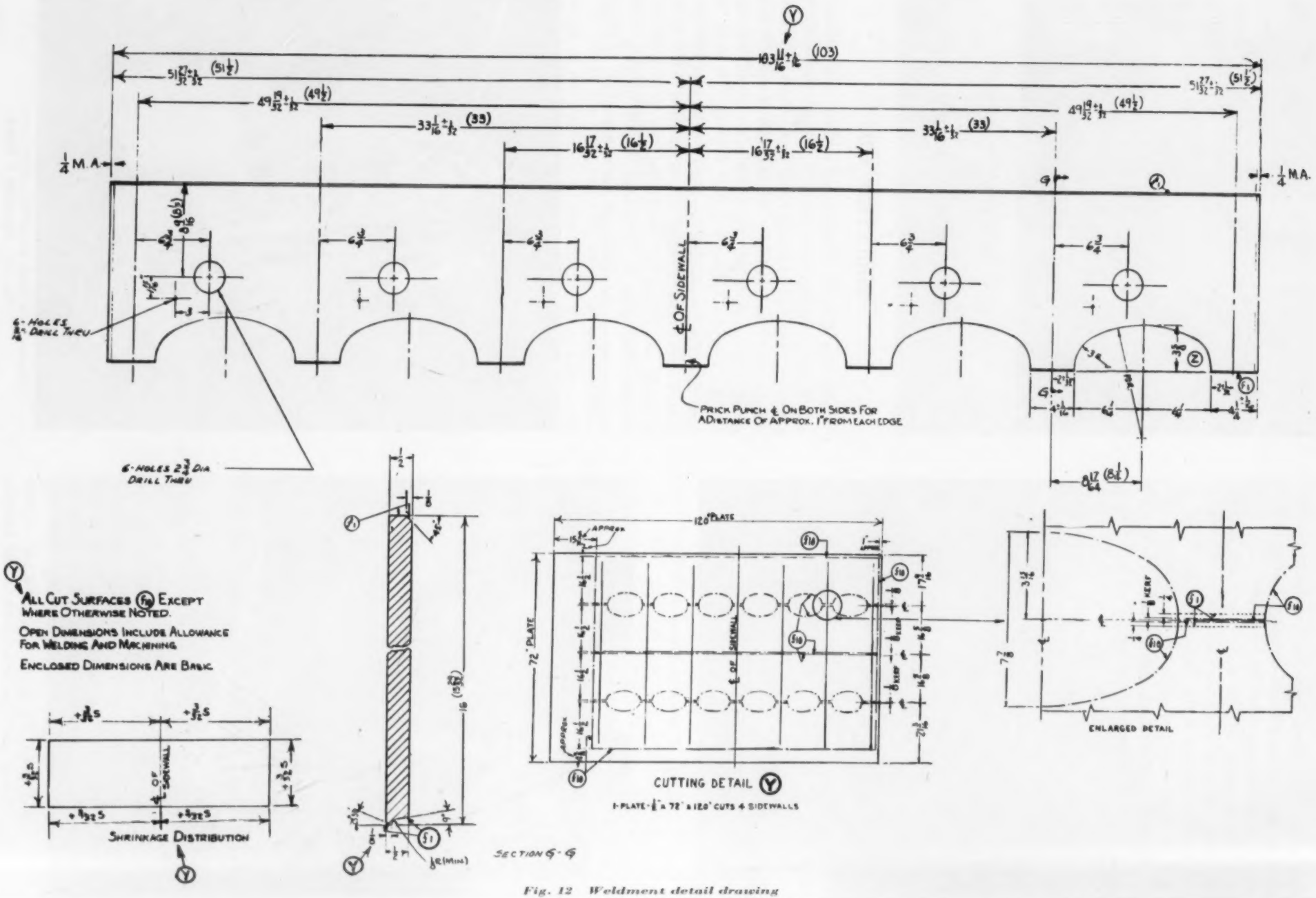

ALL CUT SURFACES (F10) EXCEPT WHERE OTHERWISE NOTED.
OPEN DIMENSIONS INCLUDE ALLOWANCE FOR WELDING AND MACHINING
ENCLOSED DIMENSIONS ARE BASIC
6-HOLES 2 3/4 DIA DRILL THRU
6-HOLES 1 1/16 DIA DRILL THRU
PRICK PUNCH ℄ ON BOTH SIDES FOR ADISTANCE OF APPROX. 1" FROM EACH EDGE
℄ OF SIDEWALL
1/4 M.A.
SHRINKAGE DISTRIBUTION
SECTION G-G
CUTTING DETAIL (Y)
1-PLATE-1" x 72" x 120" CUTS 4 SIDEWALLS
ENLARGED DETAIL
72" PLATE
120" PLATE
KERF

Fig. 12 Weldment detail drawing

case
strue
Th
their
econ
celu
strue
has
selve
which
E
tion

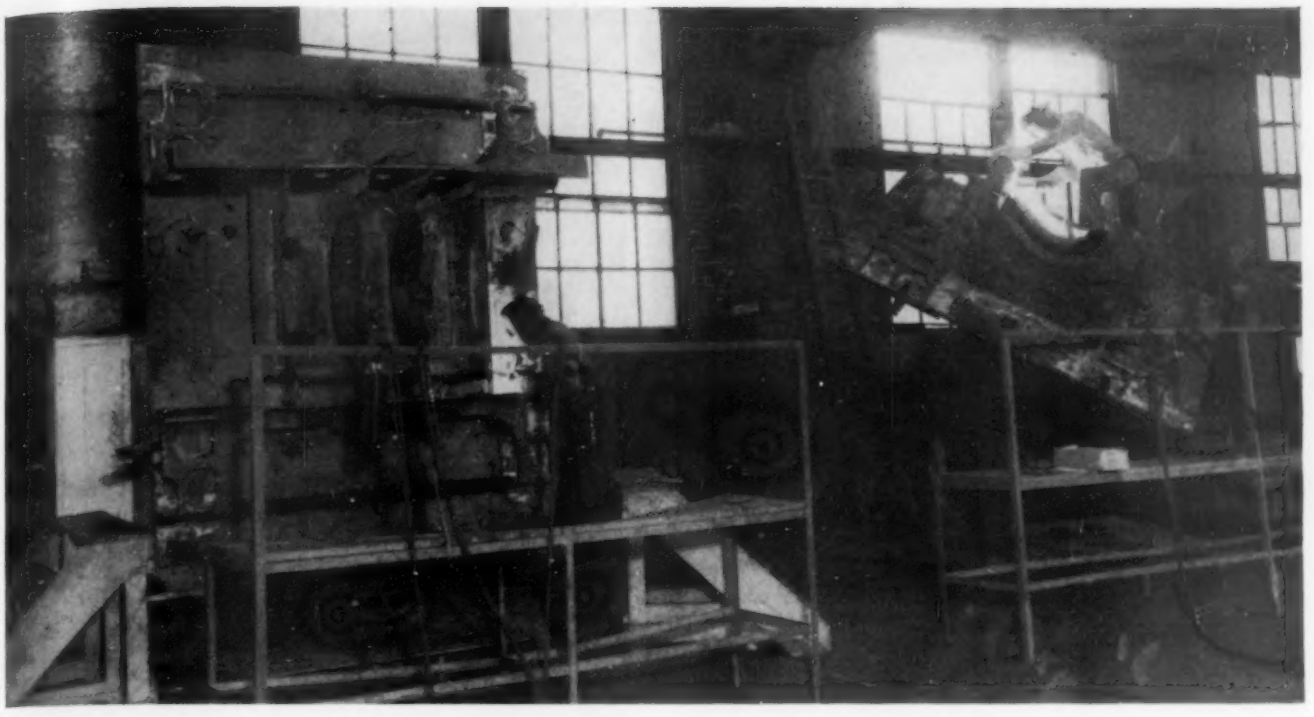


Fig. 13 Preassembly Diesel locomotive trucks

cases, a sketch of the raw material as received, with instructions for rough flame cutting, are also included.

The extensive use of fixtures and positioners, and their careful arrangement in the shops for maximum economy have oftentimes required preparation of procedure drawings for the guidance of tool and plant construction engineers. Incidentally, this type of drawing has proved invaluable among the welding men themselves, for discussion and correction of the procedures which they were planning for a given job.

Every ambitious program for the design and production of weldments in an organization, not in the habit of producing them, finds it necessary to carry on a certain amount of research in all phases of the welding sciences, and we have been no exception. One of the many interesting studies evolves about photoelastic examination of specimens representing typical welded joint cross sections, such as double fillet T connections. These specimens and associated studies convinced us that ordinary fillet welds without edge preparation, to eliminate the line of demarcation between the pieces, are satisfactory for almost all loads encountered in machinery design and, as a result, provide opportunities for real savings in production.

Fig. 12 Weldment detail drawing

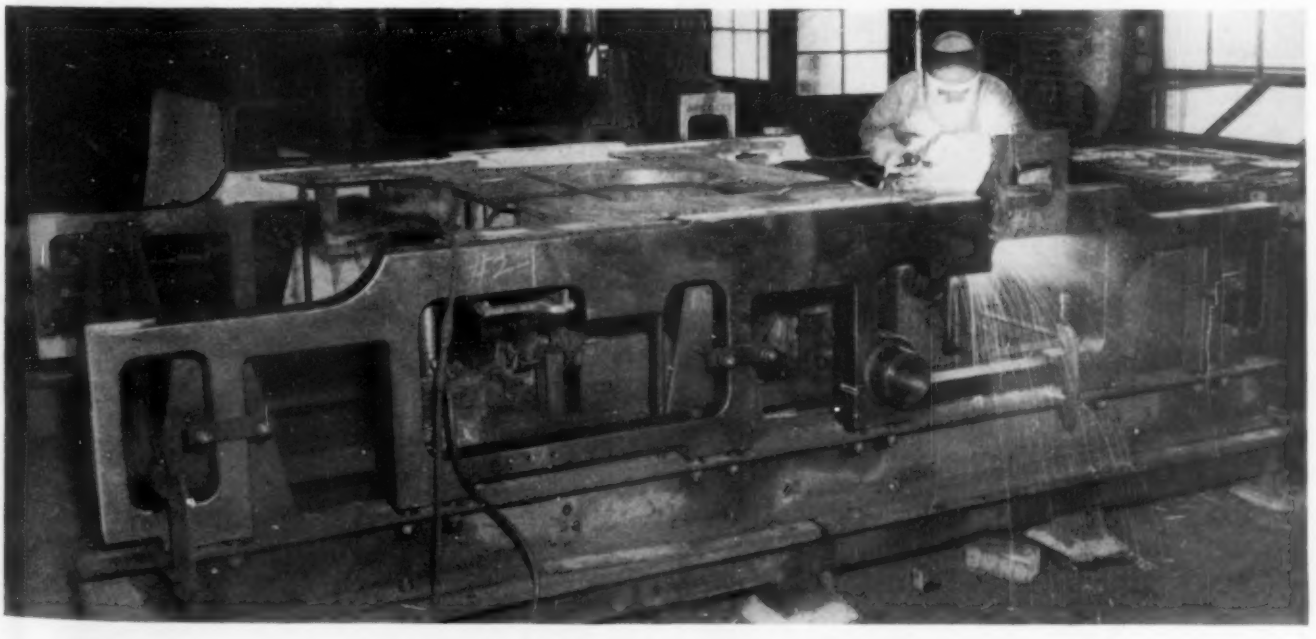


Fig. 14 Final assembly Diesel locomotive truck

THE LOCOMOTIVE

Some of our locomotives are designed with welded trucks, and for them we use side members made of flame-cut steel slabs, as may be seen in Fig. 14. We have been able to develop flame cutting tolerances on large repetitive work of this nature to the point where many of the surfaces are used as cut, and will be correct in their location to $+^{1}/_{16} - 0$ in. The trucks are made on the standard Schenectady practice of preassembly, and Fig. 13 shows two of the truck swing bolsters being fabricated on positioners. Upon completion of the positioner work, the bolsters are accurately checked and corrected, if necessary, before placement in a jig with a pair of side frames. This final assembly of the truck is carried out in a tool type of jig, shown in Fig. 14, which has provision in it for transverse shrinkage between the two side members. By this means, the side frames may be set apart by an additional amount equal to the expected shrinkage and the welds allowed to contract normally without restraint. The net result is a large weldment held to accurate dimensions and used as welded without finish machining or stress relieving.

Within the last few years, we have greatly increased our use of resistance welding and added a number of new machines. Among them is the new portable spot-welding gun, which may be seen in Fig. 15, and behind it, the window and door frames on which it is used are also clearly discernible. The water-cooled gun may be rotated through an angle of 350° so as to weld the entire periphery of a frame in one setup. We were one of the first users in the East of three-phase electrical controls for resistance welding, and have since expanded this process and control into three departments of the plant. Also, the expanded use of resistance welding has been paralleled by the adoption of as complete and accurate a fixture setup for every job as could be pro-

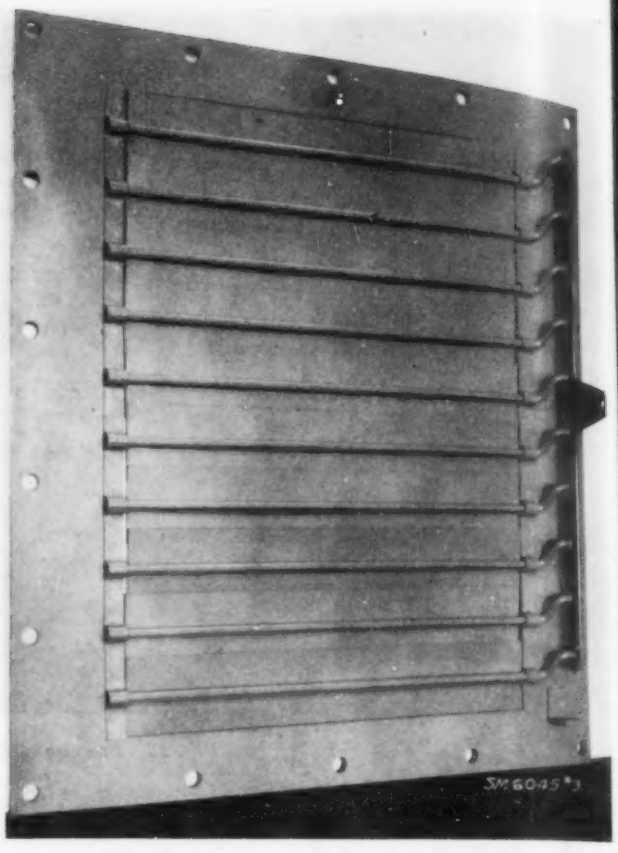


Fig. 16 Spot-welded shutter assembly

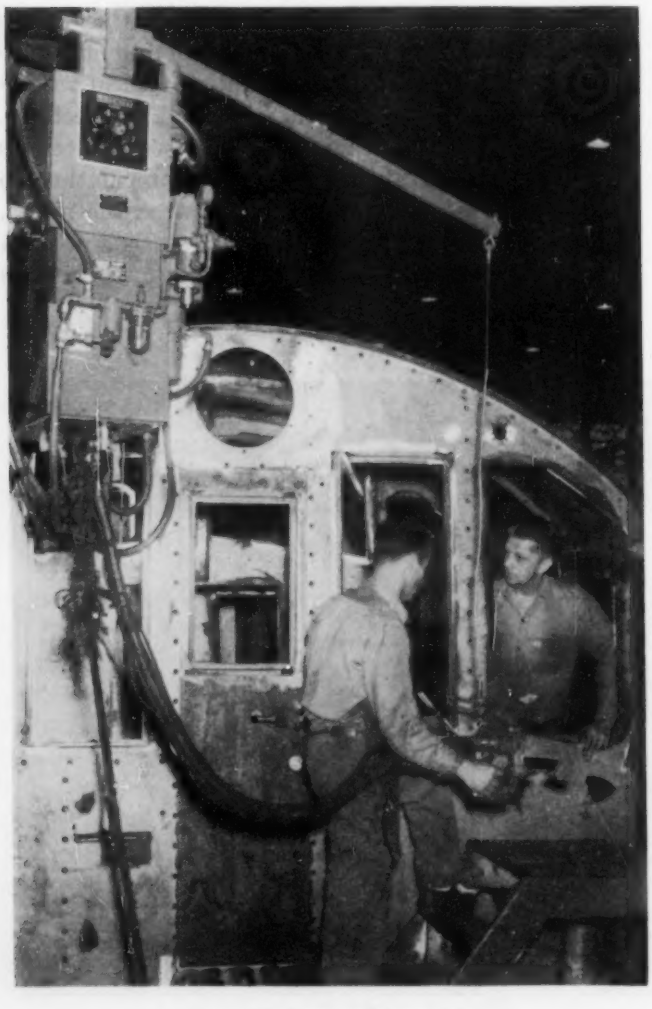


Fig. 15 Spot welding gun

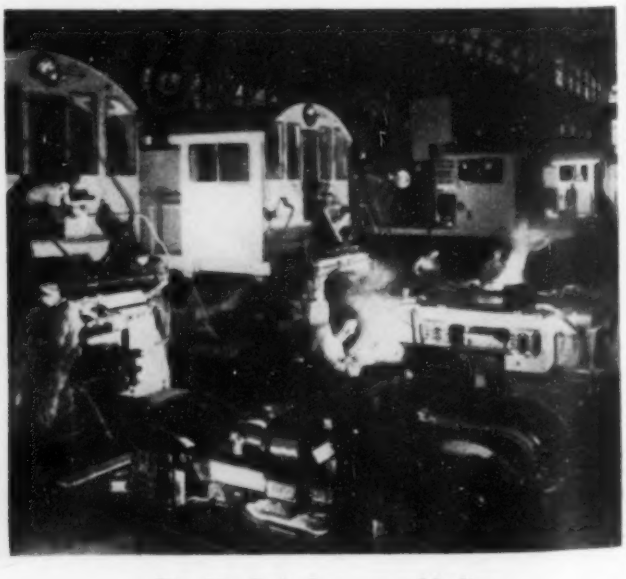


Fig. 17 Switcher assembly line

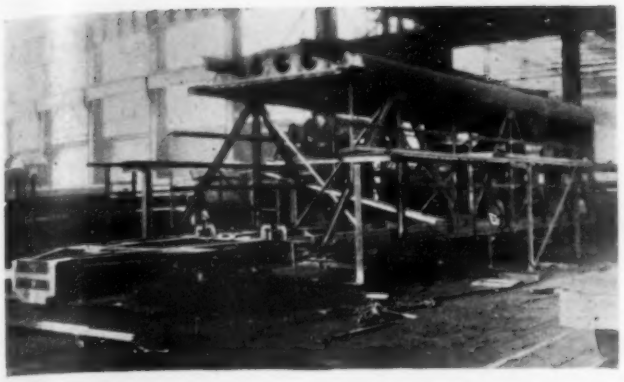


Fig. 18 Road locomotive roof, floor frame and side truss assembly

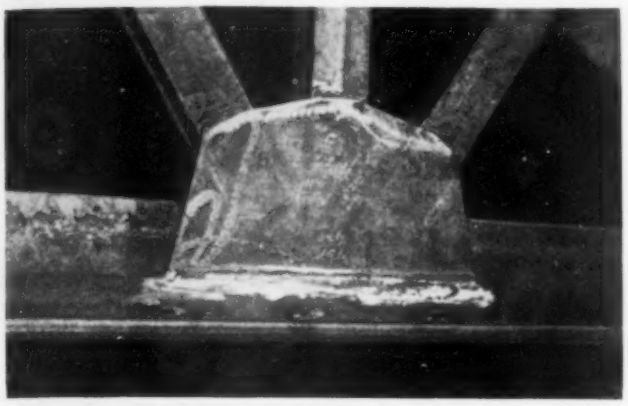


Fig. 19 Side truss detail

cured. In many cases, the fixtures used are of fine machine tool accuracy and, as a result, resistance-welded items, such as the shutter assembly shown in Fig. 16, may be made very easily with little fear of distortion or misalignment of moving parts.

The locomotives are made on a production line basis, as may be seen in Fig. 17, which is the 450-ft. specially equipped bay used for switchers of all types. All of the locomotives are built with welded frames assembled on cast-iron floor plates. They have never been a serious problem with the exception of the streamline road locomotives, where we have found it desirable to use the new A.W.S. Class E-6015 electrodes to decrease the possibility of underbead cracking in the low-alloy high-strength material required for these light weight frames. The side trusses, floor frames and roofs are each completed as preassemblies and assembled as shown in Fig. 18. The careful attention to welding detail incorporated in the design of these new locomotives is well illustrated in Fig. 19, which is a close-up of one of the truss joints. Here, the design has been so arranged that the gussets may be made by shearing, and the welds between members are terminated short of the ends of each joint involved. This eliminates one of the serious causes of weld joint failure, wherein the welders might incompletely shape their filler metal at the edges of intersecting members and leave gouges or undercuts along the lines of highest stress.

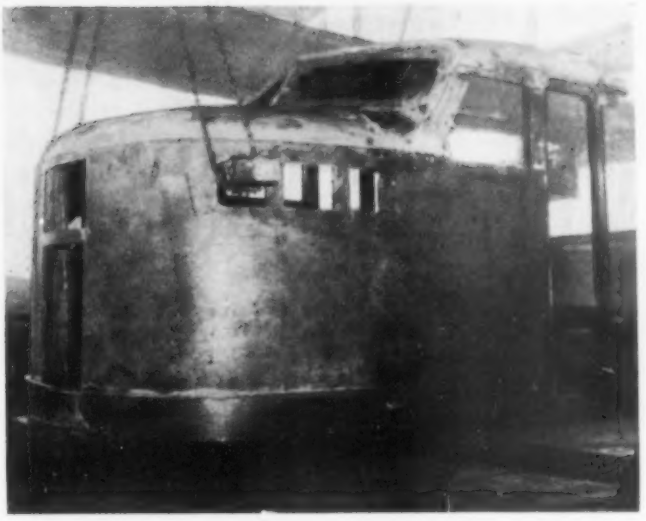


Fig. 20 Streamlined locomotive nose preassembly

Fig. 21 4500-hp. road Diesel electric locomotive

The streamline nose with the operator's cab and windows, shown in Fig. 20, is completed as a preassembly and moved into place for connection to the main body of the locomotive. In this case, specially developed A.W.S. E-6013 electrodes, and specially trained operators use very specific procedures to avoid rippling of the outside skin, as any irregularity in this surface becomes a startling flaw when the locomotive is given its final high-gloss finish.

All of this technological development is in evidence at Schenectady and Auburn, N. Y., where the American Locomotive Co. is turning out ever-increasing quantities of Diesel-electric locomotives for the nation's railroads. The assembly line techniques and production know-how developed during the recent war have done much to speed up the production of these modern giants of the rails. All of Alco's production at Schenectady is for Diesel-electric. The end of steam locomotive building attracted wide attention a few months ago. Forty per cent of the nation's Diesel-electric business is now being done by Alco and is typified by the 4500-hp Diesel-electric locomotive shown in Fig. 21 which is now an important freight service on the Missouri Pacific lines.

Structural I-Beam Cutoff Machine

The structural I-Beam cutoff machine is an unusual oxyacetylene machine designed to cut I- or H-beams from 10 to 36 in. on a steel mill roll line. The unit produces a cut surface comparable to a cold saw

by George J. Strate

THE problem of flame cutting structural shapes has been under consideration for many years. The hand torch was the first oxyacetylene tool used to cut these members. However, the hand torch has its limitations so far as speed and accuracy are concerned and, consequently, a mechanical means of guiding the hand torch was indicated as a faster and more accurate method of accomplishing the desired results. This mechanical means of guiding the hand torch consisted of three torches mounted on a frame which was clamped to the structural members. Two torches moved vertically and cut the flanges while the third torch moved horizontally on a carriage and cut the web section. While this method produced more accurate cutting, the time required to position the unit and make the cut precludes its use in a production setup such as a steel mill roll line. This unit was also comparatively fragile in construction and not suitable for steel mill use.

The machine described in this paper is a third step in the solution of the problem of flame cutting structural shapes. This third step includes the principles employed in the second step, with the addition of automatic positioning and control of the cutting torches, producing a consequent increase in the speed of the operation and, also, a much larger and more rugged machine consistent with steel mill construction practices.

The structural I-beam cutoff machine is an oxyacetylene machine designed to cut I- or H-beams from 10 to 36 in. on a steel mill roll line. The unit is designed to produce a cut surface comparable to a cold saw and to be comparatively inexpensive in initial cost, installation and maintenance. In addition to these qualities the machine is of rugged, but simple, mechanical construction to withstand steel mill usage.

The machine, Fig. 1, is a ram-type unit which mounts three torches. The I-beam is presented to the machine riding on the bottom flange. Two torches, mounted top and bottom, move horizontally and cut the top and bottom flanges perpendicular to the longitudinal axis of the I-beam. The third torch moves vertically from top to bottom and cuts the web section. All cuts match in the same plane to produce a continuous, smooth-cut surface. Figure 5 shows the position of the torches during a cut.

The main ram, gas arm and operator's pulpit are mounted on a machine carriage equipped with standard-gage railroad wheels and axles. The machine can either be moved manually, parallel to the roll table, or can be equipped with an electric-motor drive. A hand brake is supplied to lock the carriage in position on the rails.

The machine as designed is for automatic operation with the option of manual operation if required. All operations in the automatic cycle are sequenced through relays and micro-switches in the proper order so that the entire cutting cycle is completed and the machine returned to the "at rest" position after the initial signal from the operator's station.

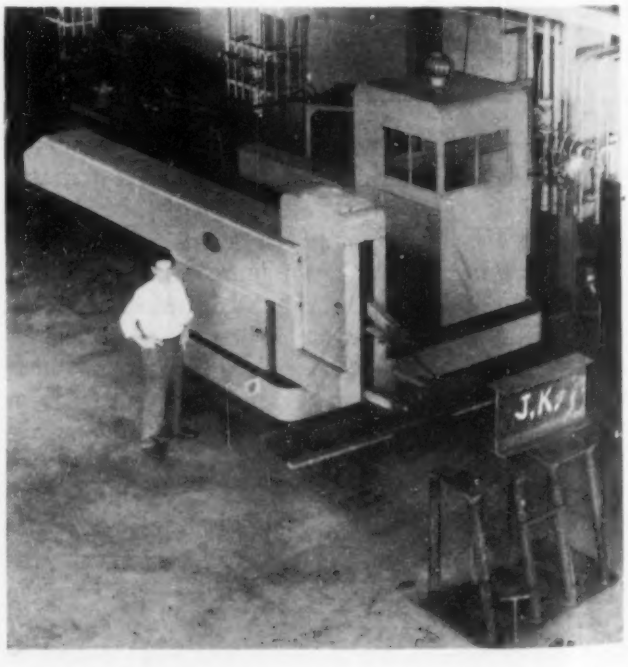


Fig. 1 General view of structural I-beam cutoff machine

George J. Strate is assistant research and development engineer, apparatus research div., Air Reduction Research Laboratories, Murray Hill, N. J.

Paper presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

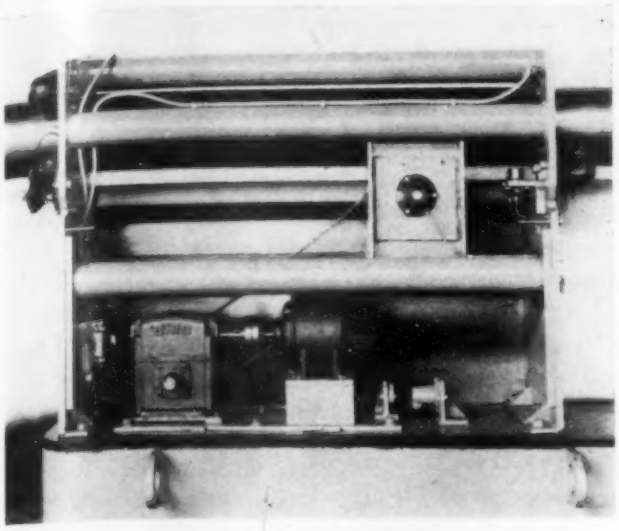


Fig. 2 Slide box and ram

A description of a completely automatic machine cycle follows: An I- or H-beam moves down the roll table and is positioned in front of the machine. The operator presses the automatic start button on the machine control desk. The main ram moves out at high speed and automatically positions the top and bottom flange torches on the edge of the beam flanges. The preheating gases of the flange tips ignite and play on the edge of the flange for a preset preheat period. At the end of the preheat period the cutting oxygen comes on and the ram starts to move across the flange at cutting speed. When the flange tips are approximately $^1/_2$ to 1 in. away from the web section, the main ram slows down to $^1/_2$ cutting speed until the flange tips have cut through the web section. The main ram then picks up cutting speed and at the same time the web-torch cutting oxygen comes on and the web torch starts to move downward at cutting speed. The main ram continues to move across the flange at cutting speed until the flange is cut through. At that time the flange-tip gases go off and the forward motion of the ram stops while the web tip continues to cut downward. When the bottom of the cut is reached, the web tip is extinguished and the main ram moves back to the "at rest" position at high speed while the web torch moves upward to its original position.

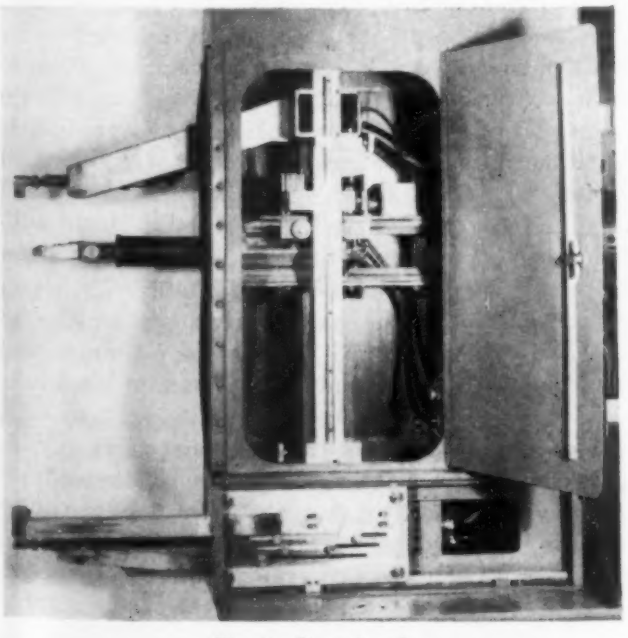


Fig. 3 Ram head

The timing for all of the above operations is preset on the machine for each beam size. Seven operations, which can be accomplished in 60 sec., are required to change the machine settings for a change in beam size.

Details of the various components of this machine will be treated individually.

RAM AND SLIDE BOX

The horizontal motion of the cutting torches is transmitted through a ram and slide box. The ram is driven by a $^1/_2$-hp. motor through a speed reducer with a chain and sprocket transmitting motion to the ram. The stroke of the ram is 84 in. which will cover a 5-ft. roll table including the line shaft.

The slide-box frame shown in Fig. 2 consists of two $1^1/_4$-in. end plates welded together with five 4-in. diam. pipes used as spacers. This type of construction provides a sturdy structure with a minimum of labor and material.

The assembly of this unit was relatively simple.

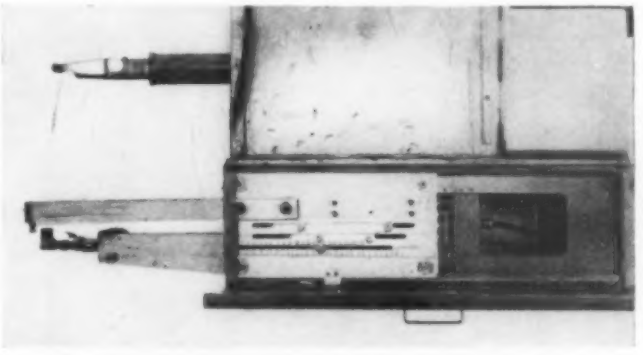


Fig. 4 Workpiece locator probe

Five bosses, slightly smaller in diameter than the I.D. of the pipes, were welded to the face of each end plate. The end plates were positioned on the machine carriage and the ends of each pipe were fitted over the bosses. The bolts holding the end plates to the machine carriage were then tightened to hold the complete structure rigidly in place for the welding of the pipes to the end plates.

The main ram consists of a $10^3/_4$-in. diam. heavy-wall steel tube. A light cut was taken from the outside diameter to provide a smooth rolling surface and to eliminate any camber of the tube.

Six guide rolls carry the ram in the slide box. The outer ring of each guide roll is machined from bronze stock with the contact surface curved to fit the contour of the ram. The outer ring of each guide roll is mounted on a self-aligning roller bearing.

RAM HEAD

The ram head shown in Fig. 3 is the supporting structure for the three cutting torches and the workpiece locator probe.

As indicated in Fig. 3 the top torch arm and the web-torch carriage are supported by two vertical 3-in. square bars while the bottom torch arm is bolted to the bottom plate of the ram head.

The top torch arm is adjustable manually in a vertical direction to set the proper cutting-tip height for various sizes of I-beams. The position of the top torch arm is maintained by a clamping action on the two vertical square bars as shown in Fig. 3. To change the position of the top torch arm, the clamp nut on the back of the arm is loosened, the arm repositioned, and the clamp nut retightened.

The web-torch carriage, Fig. 3, is mounted between the two vertical 3-in. square bars. The carriage rides on cam followers mounted in eccentric bushings to provide close contact with the vertical guide members. The web-torch carriage is driven vertically by means of roller chain and sprockets. The motive power is supplied by a $^1/_4$-hp. motor and speed reducer.

The horizontal motion of the web torch is provided by a separate carriage which is mounted on the top of the main web-torch carriage. This second carriage is spring loaded. In the cutting position the web torch retracts into the ram head as the top and bottom flange torches move across the I-beam. This construction

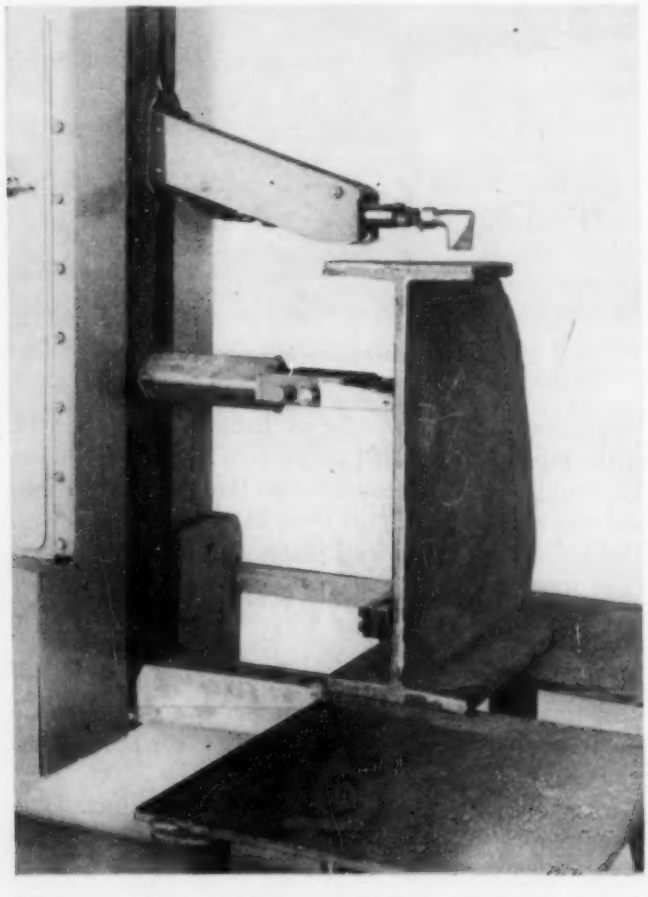


Fig. 5 Front view of ram head showing cutting torch position and four-slide zipper

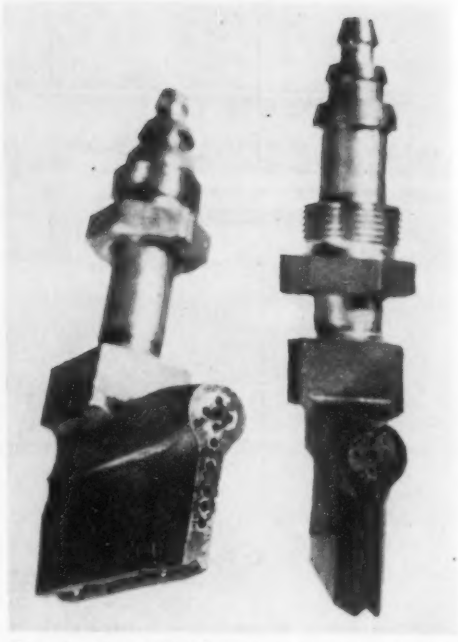


Fig. 6 Special 90° cutting tips with leading preheat

insures positive tip separation of the web cutting tip during the progress of a cut.

The bottom flange torch is mounted in a fixed position at the bottom of the ram head. This torch is adjusted for proper cutting-tip height at the time of the machine installation and should require no further attention.

The workpiece locator probe shown in Fig. 4 is the controlling mechanism for the automatic operation of the machine. This device consists of a spring-loaded retractable carriage, a probe arm and adjustable slides for tripping the limit switches. The limit switches can be seen to the right of the carriage. The probe carriage rides on four guide rollers grooved to fit hexagonal barstock tracks. The guide rollers are mounted in eccentric bushings.

The workpiece locator probe, Fig. 4, operates as follows: As the main ram moves out to the roll table, the front of the probe arm comes in contact with the bottom flange of the I-beam. The main ram continues to move, causing the retractable carriage to move to the right until the first adjustable slide, shown held in position by the two top cap screws, trips, the top limit switch. This limit switch opens the circuit to the main ram drive motor and stops the motor which stops the movement of the ram. If the ram should coast forward beyond this point, the second adjustable slide, shown held in position by the second two cap screws, trips the second limit switch which reverses the main ram drive motor and moves the ram back. The ram hunts for a second or two between these two limit switches until it comes to rest. The probe arm has been previously adjusted so that, when the ram is stopped between these two limit switches, the flange tips are positioned over the top and bottom edges of the flanges of the I-beam. The settings of these first two slides are not changed once the relationship between the probe and the flange tips is established.

As soon as the ram is stopped between the two limit switches, the preheat gases of the two flange tips turn on and an adjustable time-delay relay goes into operation. This time-delay relay has been preset to a predetermined preheat interval. At the end of this interval, the flange tip cutting oxygen comes on and the ram moves forward at cutting speed. With the ram moving forward again, the probe carriage continues to move to the right until the third slide trips the third limit switch. This third limit switch cuts down the forward speed of the main ram to one-half cutting speed and turns on the web-torch preheat gases. The third slide is adjusted to operate when the flange tips are within $^1/_2$ to 1 in. of the web section. This slow down to one-half cutting speed enables the flange tips to cut a deep notch into the web section as they pass over it. The main ram continues to move at one-half cutting speed and the probe carriage continues to move to the right until the fourth adjustable slide trips the fourth limit switch. This fourth limit switch changes the main ram speed to full cutting speed again, turns on the web-torch cutting oxygen, and starts the web torch moving down the web section. The fourth slide is adjusted to operate at the moment that the flange tips break through the web section.

The main ram continues to move forward and the probe carriage continues to move to the right until the flange tips have completed the cut on the flange sections. At this point the fifth adjustable slide has been set to trip the fifth limit switch which stops the motion of the main ram and shuts off the flange tip gases.

When the main ram retracts at the end of the cutting cycle the spring on the probe carriage returns it to position for the next cut.

The front slot of the ram head shown in Fig. 5, which permits movement of the web and top flange torches in a vertical direction, is closed with a four-slide zipper. This zipper opens in front and closes behind the torch arms as they move up or down. The zipper is sewed into two pieces of fireproof canvas.

CUTTING TIPS

Flange-Section Tips

The cutting tips for the flange sections shown in Fig. 6 are special 90° tips with leading preheat flames. The purpose of the leading preheat flames is to provide preheat to the edge of the flanges without requiring accurate positioning of the cutting-oxygen stream for the start of a cut.

These cutting tips are of 4-piece construction consisting of the tip body, the cutting-orifice insert, the mixer and the tip nut.

The tip body is of identical construction for all sizes of cutting orifices. It contains five leading preheat holes spaced to provide a maximum of preheat at a point farthest from the cutting orifice.

The cutting-orifice insert is machined from stainless steel and silver soldered into the tip body. Four gas preheat holes, whose size and angle are determined by the size of the cutting orifice, are spaced around the cutting-oxygen orifice. Cutting-orifice sizes range from No. 1 through No. 5. Access to the gas-distribution passages for cleaning purposes is made possible through clean-out ports.

Web-Section Tip

The web-section cutting tip is a standard cutting tip with a medium preheat. Most cutting has been done with an Airco style 138 cutting tip. It is imperative that the diameter of the cutting orifice of the web tip be of the same size as that of the flange tips.

Pilot lights are supplied for each cutting tip. These lights burn continuously during the hours that the machine is in operation.

GAS SYSTEM

Oxygen, acetylene and air for the operation of the machine are brought in from the customer's lines through rubber hoses to the end of the gas arm. From the end of the gas arm the gases are piped to the gas-distribution cabinet shown in Fig. 7. The gas-distribution cabinet mounts the regulators as shown with trimmer valves supplied on the down-stream side of the

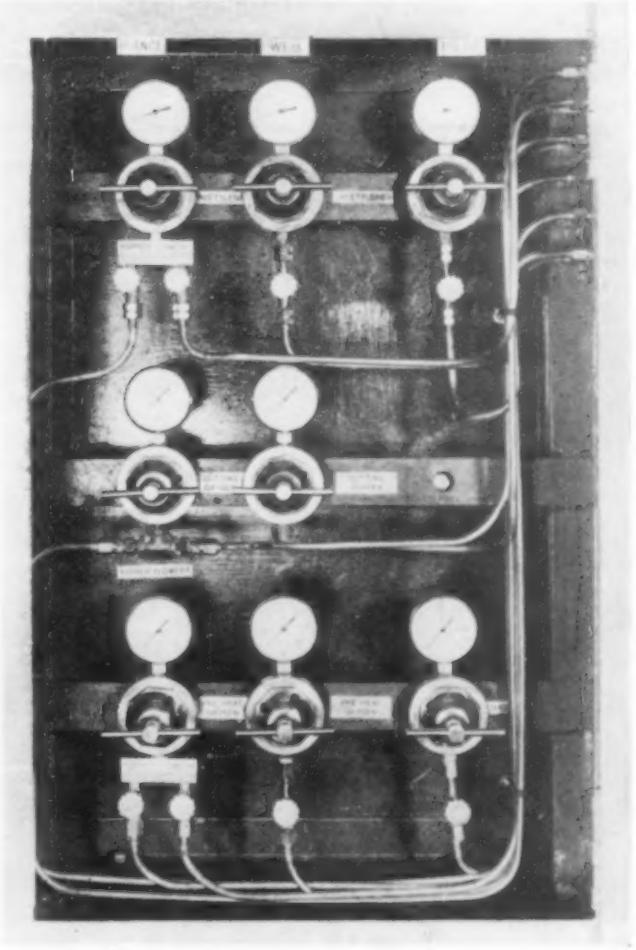


Fig. 7 Gas distribution cabinet

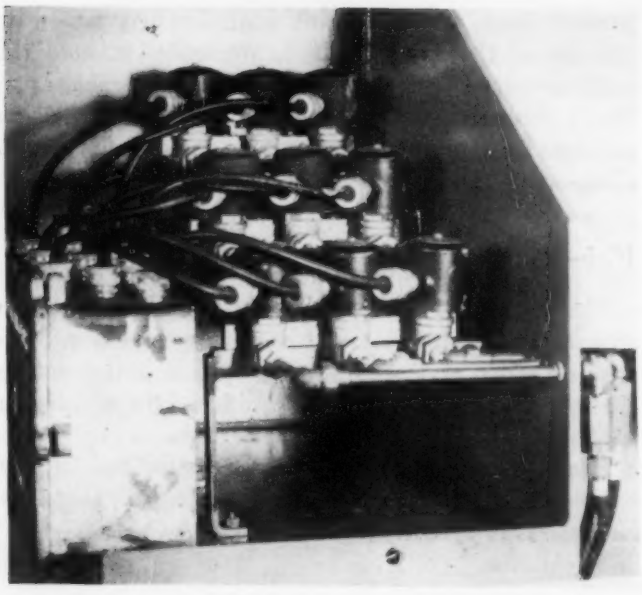


Fig. 8 Solenoid valves for control of gases shown mounted on rear of ram

regulators to adjust the proper flow of gases to the cutting tips.

The gases are piped from the regulator cabinet back through the gas arm to the outlet connections on the end of the gas arm. From these outlet connections the gases are carried through long flexible hoses to the rear of the main ram where they are connected to solenoid valves as shown in Fig. 8. Each gas line is equipped with a filter. The gases are piped through the ram to a header in the ram head. Distribution to the cutting torches is made through flexible rubber hoses from the header.

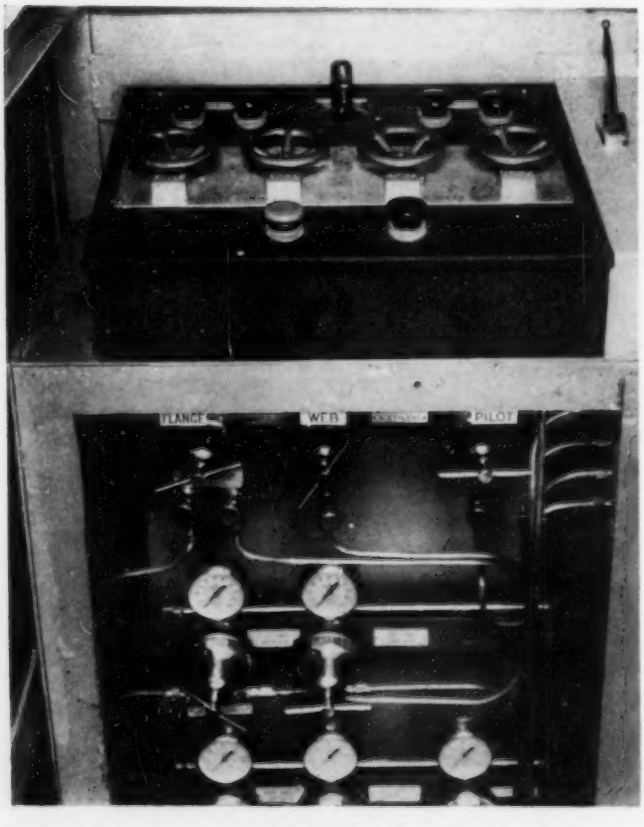


Fig. 9 Operators desk mounted on top of gas distribution cabinet

OPERATOR'S CONTROL DESK

Shown in Fig. 9 is the operator's control desk. This desk is mounted on top of the gas-distribution cabinet to permit access to all machine controls.

The four push buttons, shown in the top row, are for jogging the ram and web torches for position. The switch in the top row controls the solenoid valves for the gases. With this switch in the "off" position, the machine can be test-operated without opening the solenoid valves.

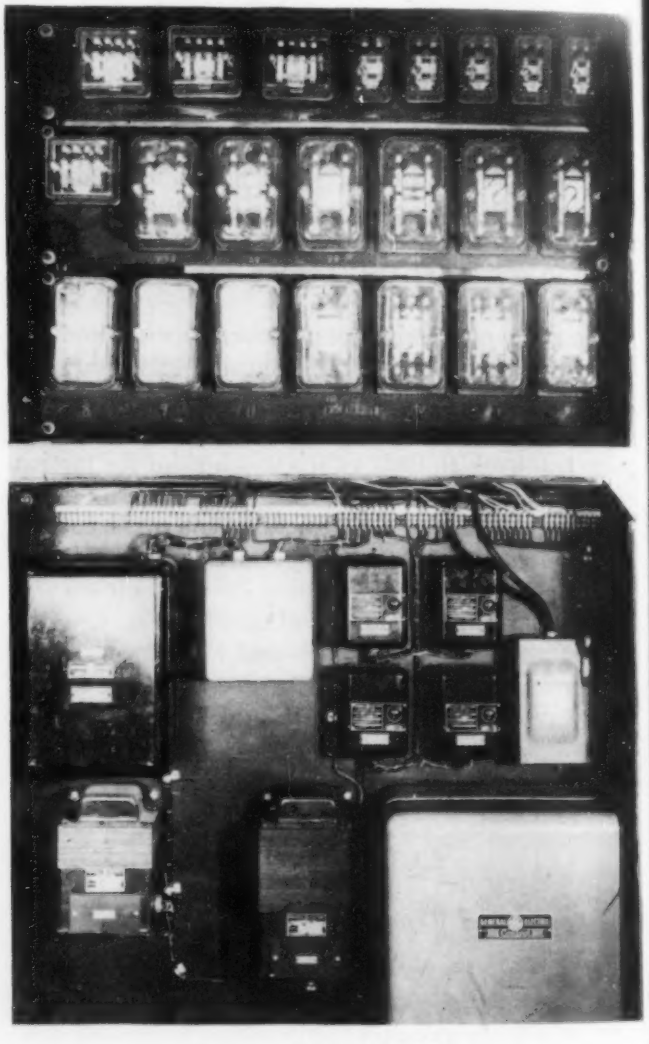


Fig. 10 Electrical cabinet

The four hand wheels in the middle row control the forward and reverse speeds of the ram and web torches. These speeds can be preset before operating the automatic cycle or changed during the cycle.

The two buttons in the bottom row control the start and stop operations of the machine. The button on the right is the automatic start button. This button starts the completely automatic cycle of the machine. No further action on the part of the machine operator is necessary during the cutting cycle unless it is desired

to stop the machine before the cutting cycle is completed. If the operator desires to stop the machine during the cutting cycle, he pushes the button on the left, which is the "emergency stop" button. This button stops the motion of the ram and the web torch and shuts off the gases.

The automatic start button performs an additional function. If the machine is stopped before completing the cutting cycle, the jog buttons may be used to position the ram or web torches at the proper point. The automatic start button is then pressed and held down until the ram starts to move forward. The button may then be released and the cutting cycle will be completed automatically.

ELECTRICAL CONTROL CABINET

The electrical controls for the motors and solenoid valves are located in the electrical-control cabinet shown in Fig. 10. This cabinet may be located at any point within 100 ft. of the machine proper.

The motor controls consist of a 1-hp. G. E. thymotrol panel for the ram motor and a $^1/_2$-hp. thymotrcl panel for the web motor. These thymotrol panels provide constant, stepless control over the machine-cutting speeds.

Four adjustable time-delay relays are provided to control the flow of gases and the movement of the cutting torches during the automatic cutting cycle. Two time-delay relays control the time interval between the operation of the acetylene solenoids and the oxygen solenoids. These allow the acetylene to flow before the preheat oxygen. A third adjustable time-delay relay controls the preheat interval of the flange torches prior to the start of a cut. The fourth adjustable time-delay relay controls the ignition of the web-cutting torch prior to the start of the web cut. This fourth relay is the only one that requires adjustment for each change of beam size.

In the upper part of the electrical-control cabinet are shown additional relays for controlling the various operations during cutting cycle.

CONCLUSIONS

No investigation was made of other methods of cutting I- or H-beams with respect to cost of cutting and maintenance. However, as a matter of information, the operating data for making a cut on one particular beam size with this machine is listed below:

Beam size:

Weight of beams, lb. per ft	62
Flange width, in.	21 x $8^1/_4$
Flange thickness, in.	0.615
Web thickness, in.	0.400
Preheat period, sec.	15
Cutting time, actual, sec.	75
Total elapsed time for one cut, sec.	90
Oxygen consumption, cu. ft.	15
Acetylene consumption, cu. ft.	2.5
Machine power requirement, kva.	2

Cutting tips will not require replacement for an indefinite period if periodic maintenance is provided.

Metallizing as a Production Process

Metallizing is one of the useful allied processes to the welding industry. Interesting maintenance and production applications are described and information given on preparation for metallizing and relative costs

by Knowles B. Smith

METALLIZING, as defined by Webster, is "coating with a metal or metallic compound" or more loosely, if such is possible, "the application of a metal coating." To those of us in the welding industry and to our colleagues such as plant engineers, master mechanics, metallurgical engineers and others of industry, the word metallizing refers to a process which has a very specific meaning.

We immediately think of a synonymous term for the process which is "metal spraying." Both terms are used in referring to the application of metal through the use of a so-called metallizing gun. This tool transforms the metal from wire or powdered form into a molten state by either an oxyacetylene, oxypropane or oxyhydrogen flame. A compressed air stream at 60 to 70 psi. then breaks the molten metal into finely atomized particles and these particles form the metal

Knowles B. Smith is vice-president and general manager, Dix Engineering Co., Inc., Lincoln Park 25, Mich.

This paper was presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

spray or metal coating which is referred to by Webster.

The metallizing process was originated in Europe a few years prior to World War I. It did not become a practical means of applying a metal coating until the early 1930's when metallizing equipment developed by American enterprise and ingenuity was made available to industry. In a comparative short space of years the metallizing process has made rapid strides of development both from the standpoint of equipment and increased applications along with improved techniques.

MAINTENANCE APPLICATIONS

During the depression years metallizing equipment had a particular appeal to those in industry who were charged with the responsibility of keeping plant maintenance costs at a minimum. They soon found that they could restore many types of worn bearing and packing journals to original dimensions at a much lower cost than that of a new replacement part.

During the years of World War II, the process was used as a plant maintenance tool primarily to save critical metals and to reduce production "down-time." However, production men soon realized its value as a "puttin'-on-tool" in salvaging many mis-machined production pieces which would normally be scrapped. In the later years of the war production salvage by metallizing became a volume proposition in many plants.

PRODUCTION APPLICATIONS

Prior to and during World War II a few production applications for the metallizing process were developed. Perhaps the best known production use for metallizing during the war was that of spraying the cooling fins of aircraft engine cylinders to protect them against heat oxidation and salt atmosphere corrosion and to increase heat transfer efficiency. An automatic machine was developed which applied the desired thickness of sprayed aluminum to the exterior of the cylinders on a continuous production schedule. This application directed the thinking of many war production engineers along the lines of employing the metallizing process for applying metallic coatings on various production pieces. By V-J Day several production metal spraying operations were being carried on as daily routine in various plants.

Upon return of industry to a peacetime production economy of producing consumer goods, production, process, design, tool and welding engineers naturally fell into the pattern of getting civilian goods rolling off their production lines in the shortest possible time. There was no time for new designing, new production processes or new methods. By and large the potentialities of metallizing as a production process were lost in the shuffle.

However, some of the manufacturers who pioneered the use of metallizing as a production process prior to and during the war did continue with their efforts. These efforts have been rewarded and have resulted in mass producing many items which require a metallic coating at a lower cost and at an increased production rate.

At the present time the metallizing process is employed on a production basis for applying metal to metal, glass, ceramics, wood, fiber, plastics, cloth, paper and other materials, depending on the purpose and end requirements demanded of the metallic coating.

One of the oldest production metallizing applications will serve as an illustration of the process aptly applied on a continuous run production basis. This application involves coating various sections of many different types of carbon resistors and carbon electric motor brushes with sprayed copper. Previously the copper was applied by the electroplating process. Intricate mashing was involved and after the desired amount of copper was plated onto the carbon the pieces had to go through a dehydration oven to drive off the plating acids. These steps were costly and added to the unit cost of items which had to be mass produced at the lowest possible unit cost.

After considerable trial and error research it was found that the metallizing process was the best possible alternative for reducing the unit cost of applying copper to these pieces. It was found that by using a conventional oxyacetylene metallizing gun with 15 B & S gage or smaller copper wire, the carbon pieces ranging from $^1/_{16}$ in. in diameter to large electric motor carbon brushes could be sprayed with a desired thickness of copper. Furthermore, by various shielding and masking techniques it was found that a specific sized area on the carbon piece could be sprayed. These experiments were all with manually operated metallizing equipment.

When it was proved that the sprayed copper coating had many physical and cost advantages over the plating method, it was a simple matter for mechanical handling design engineers to work out a practical means of conveyorizing of the carbon pieces of uniform size past a continuously operating metallizing gun.

The thickness of the sprayed copper coating is important in the production of carbon resistors. This thickness is controlled by the conveyor speed of the pieces past the fixed metallizing gun or multiple guns, whichever the case may be.

With a given diameter of copper wire being used in the metallizing gun, it is a matter of comparative simple calculation to arrive at the proper speed of the pieces passing the gun in order to receive the desired thickness coating of sprayed copper. The number of square inches of copper which can be sprayed per minute to a thickness of "X" thousandths of an inch can readily be determined from data tables formulated for all metals and all standard wire sizes which can be used in a conventional metallizing gun. The same type of data is also available for metallizing equipment employing powdered metal in place of wire.

Thus we see that the time element in relation to the thickness coating required is equally as important in metallizing as it is in plating and other processes.

PREPARATION OF SURFACE

The preparation of the surface of the material to be sprayed presented no problem in the case of the carbon pieces. They required no preparation because the carbon in its compressed form has sufficient surface roughness to afford good mechanical adherence of the sprayed copper particles to the carbon. This holds true in the case of unglazed ceramic pieces as well as other materials with comparatively porous surfaces.

In the case of pieces which may be of metal, smooth plastic, fiber and other materials which may have dense smooth surfaces, it is then necessary to roughen the surface which is to receive the sprayed metal. Usually this is accomplished by blasting the surface with an abrasive material such as aluminum oxide, angular steel grit, flint sand or other abrasive material which is directed at the surface to be prepared with sufficient velocity to give the required roughened surface. The preparation procedure will vary according to the nature of the material which is to be metallized and the thickness of the required sprayed metal coating. Generally speaking, as the thickness of required sprayed metal increases the need for better surface preparation also increases.

A recent magazine article describing a production metallizing application illustrates the preparation problem solution in the case of a plastic material. In this case, sprayed metal is used to replace the hand labor of intricate wiring required on domestic radio receiving sets.

British and American process and design engineers designed a radio set which used a plastic material as a mounting base for the parts of the set. The molded plastic base has a simplified wiring circuit molded as an indentation when the base is formed in the plastic mold.

To prepare these plastic bases for receiving sprayed metal, they are conveyorized through an abrasive blasting cabinet where the molded indentations for the wiring circuit are roughened by the abrasive material. The plastic pieces then pass into a metallizing booth where automatically operated metallizing guns spray the circuit indentations with the required thickness of sprayed metal. The end result is a radio base with a complete metal sprayed circuit which requires very little hand labor for a minimum number of soldered connections. Without such abrasive blast preparation of the plastic material, the sprayed metal would have little or no mechanical adherence to the plastic.

As a material for receiving sprayed metal, glass offers a different preparation problem. Although low-pressure abrasive blasting has been used in some instances for preparing glass for sprayed metal, most current production metallizing applications on glass use a different method.

The area of the glass piece which is to be sprayed is preheated to a preplastic temperature. At this point, through suitable electronic temperature controls and proper conveyor design, the glass is passed before the effective spraying area of the metallizing gun and the desired area is metal sprayed with the required thickness of metal. With this type of preparation a form of chemo-physical bond is obtained between the glass and sprayed metal which virtually approaches a quasi fusion.

This method of preparation of glass has been used for a number of years in production by several manufacturers for accomplishing a soldered bond of metal to glass. One of the dual window pane manufacturers employs this method for preparing the edges of the panes for soldering a metal channel separator to the glass. In this way it is possible to exhaust the air between the panes and then hermetically seal them.

Another manufacturer has used this method to produce a meter box with a glass window soldered to the meter case. Here again the manufacturer is able to hermetically seal the meter unit against moisture or corrosive atmosphere.

Cloth and paper can and are being metallized on a production basis. Here the proper materials are selected by the manufacturers so that no preparation of the materials is required before metallizing. Mechanical adherence of the sprayed metal is controlled by the surface texture of the cloth or paper used. A highly glazed paper would not lend itself to the bonding of sprayed metal. By the same token a tightly woven and sized cloth would not offer a good bond for the sprayed metal.

The fact that one of the inherent characteristics of sprayed metal demands that it have a proper mechanical or chemo-physical bond to the base material is often a limiting factor. However, in most instances, this limiting factor can be eliminated from the outset if the product or piece which is to be metal coated can be designed from the initial stages with the requirements of the metallizing process being firmly established in the minds of the design, process and production engineers. Too often, the product has been designed and completely tooled before serious consideration is given to the employment of metallizing.

In recent months the author was called on for consultation with regard to production metal spraying of an automotive subassembly. The unit to be sprayed was a stamping of 16-gage steel. It was a deep draw of generally irregular contours. The piece presented no particular problems as to conveyorizing it past a series of automatically operated metallizing guns to obtain a uniform coverage of sprayed aluminum to a thickness of approximately 0.006 in.

The prime limiting factor was the preparation required prior to metallizing. To form the proper bond for the sprayed aluminum to the steel stamping, the steel surface first had to be free of oil and drawing compound. This required a degreasing operation which would also have been required for plating or

enameling. In addition to degreasing, the steel surface had to be roughened and free of oxides in order to afford the proper mechanical bond for the sprayed aluminum. Any one of several types of automatic blast cleaning machines could be employed to perform this latter operation. However, it was found that, due to the design, of the stamping, it was impossible to efficiently blast the desired surface with an automatically operated blasting setup. The obvious alternative was to consider using a series of hand-operated blasting cabinets and blast the individual pieces manually. A bit of quick cost analysis revealed that the hand-blasting operation would prohibit the metal coating of the piece by the metallizing process. The engineers assigned to the project conceded that if the unit had been designed from the outset for metal coating by metallizing our preparation barrier would have been eliminated. However, the stamping dies were all made and a trial production run of stampings had been made before the metallizing process was considered.

We cannot generalize and say that in every instance the problem of metal coating a piece on a production basis could be solved by metallizing if the original design concept provided for it. However, if this practice of considering metallizing in the initial design stages were followed, it is certain that the process would be more widely accepted and used for applying metal coatings on a production basis.

RELATIVE COST

Metallizing in most instances is competing with such processes as hot dip galvanizing, plating, painting, enameling and various chemical dip processes which protect steel surfaces against oxidation and corrosion. More often than not the cost per unit for accomplishing the desired end result is the prime controlling factor. Relative initial capital outlay for equipment to perform a process is also a major consideration.

Metallizing guns and the necessary accessory equipment are relatively high in cost per pound weight of the equipment. They are precision tools and require careful and regular maintenance. But the initial cost of a production metallizing installation is often much less than the initial outlay for equipment of competing processes. This fact is not generally recognized by production engineers. Many of them conclude without investigation that the cost of production metallizing equipment would be prohibitive.

In review, we can say that the metallizing process can and is being effectively and economically employed as a production means of applying a metal coating to metal, wood, plastics, fiber, cloth, paper and glass.

Due to the fact that some materials must be prepared in order to permit a satisfactory bond between them and the sprayed metal, certain limitations arise in the employment of the process.

Product design, production cost analysis, sprayed metallurgy and initial capital outlay all have to be given thorough consideration in reaching a conclusion as to the practicability of employing metallizing as a production metal coating process.

We cannot formulate any slide rule data as to where and when the process can be used in preference to other processes. It is not a process which is a panacea for all metal coating problems. The important fact remains, that as long as industry is aware of the potentialities of the metallizing process as a production means of applying a metal coating, it will always be considered from the outset as a possible solution to a metal coating problem in the design of a product or product component.

To date, the reverse has been true. In most instances the metallizing process has been reviewed only as a "last straw" possibility of a means for applying a metal coating.

We of the welding industry have been as guilty as the next engineer when it comes to apathy and lack of open mindedness regarding the process. A concrete illustration of this fact took place in recent months at a panel discussion being held by a group of welding engineers. One of the panel questions referred to the metallizing process as a possible solution to a particular metal coating production problem. The welding engineer who was delegated to answer this question, flatly stated that he could think of no instance where metallizing could be economically and practically employed as a production process.

Although we of the welding industry cannot be expected to know all the answers pertaining to welding or correlated problems, we are certainly obligated to our profession to maintain an open-minded approach to new processes and techniques.

The fact that metallizing has not been widely publicized as a production process is somewhat synonymous to the early days of arc and resistance welding. It is believed that in the near future, through proper process, design and research education, the metallizing process will become universally accepted as a production means of applying metallic coatings.

Production Heli-Welding Stainless Steel

A practical article describing when to use inert gas welding, choice of manual or automatic welding, type of electrode and methods used

by Bernard Blickman and Newton Blickman

DURING the past several years, the field of inert gas welding has expanded to such an extent, because of the economies which may be effected by its proper use, that the process is of universal interest as a possible method for the welding of almost all of the well-known metals and alloys. This paper will deal primarily with the application from a practical production standpoint of some of the techniques and equipment used in the inert gas welding of the stainless steel alloys. For the most part, this paper will be confined to the welding of the 300 series of stainless alloys using helium as the shielding gas and direct current as the power source. We have limited the paper to helium with direct current because our experience has been obtained along these lines.

The following general topics will be discussed, and specific production examples will illustrate them:

1. When to use heli-welding instead of the better-known methods.
2. Choice of manual, semiautomatic or complete automatic for a specific job,
3. Type of electrode to be used.
4. Speed of operation.
5. The use of filler material and the methods used in applying filler.

Due to the fact that a great many papers and reports have been delivered on the subject of power source, we will make no attempt in this paper to call attention to this point. We feel the same is true in regard to the choice of inert gas and, therefore, will avoid commenting on this issue.

Bernard Blickman and **Newton Blickman** are associated with S. Blickman, Inc., Weehawken, N. J.

This paper was presented at the Twenty-Ninth Annual Meeting, A.W.S., Philadelphia, Pa., week of Oct. 24, 1948.

APPLICATION OF INERT GAS WELDING

Generally speaking, almost any stainless steel job can be welded by any one or more of the common welding processes, such as metallic arc, submerged melt, acetylene or hydrogen gas welding, atomic hydrogen or inert gas. However, from the economical, metallurgical and practical standpoints, it is necessary to choose for a particular job the one process which appears best. Experience has shown that with proper equipment all gages from 0.010 to $^3/_{16}$ in. thick can be welded successfully, and in many cases, economically, using inert gas. Undoubtedly, the greatest advantage in using inert gas welding on stainless steel is obtained where a finished surface after welding is required. Great economies are obtained because of the small reinforcing and penetration resulting when this procedure is used properly.

You will note from Fig. 1 that the reinforcing of the weld is very small and when properly done should not exceed one-third in thickness of the metal welded. In fact, a feat more difficult, in achieving successful heli-welds where filler is not used, is to obtain a weld free of undercut on the top side. Welds of such quality and uniformity may be obtained that finishing operations may be performed using automatic or mechanical devices.

Another good application for heli-welding occurs when light gages are to be joined. Before the wide-

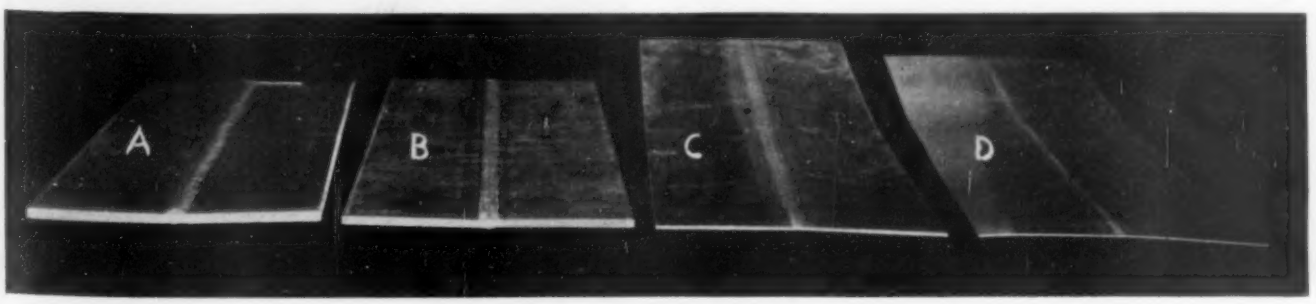


Fig. 1 Samples of heli-welding

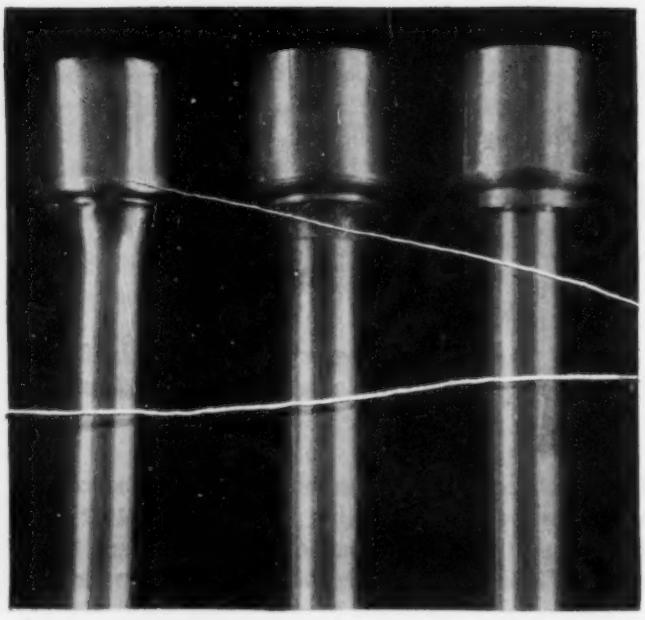


Fig. 2 "Melting down" technique. Left shows parts before welding

spread use of heli-welding, it was very common to use gas welding on very light gages and to suffer considerable distortion and possible metallurgical disturbances when certain alloys were fabricated. Using inert gas, an experienced operator is able to effect satisfactory butt welds on No. 20 gage and corner welds on metal considerably thinner. The ability to achieve good results on corner and edge welds makes the process highly desirable in the manufacture of rectangular boxes, square corner sinks, light gage trays and other similar products.

Our experience indicates, in regard to the joining of light gages, that with the inert gas method, welds are made with less distortion and discoloration than those made by other fusion processes.

Another general use for this process may best be described as "melting down." Figure 2 shows examples of this application. As seen from Fig. 2 a boss is used as filler material. The same effect may be obtained by using a metal disk or a wire-formed ring to be fused into the parts to be joined. During the welding period, the molten pool is very clearly defined, and thus a very neat appearing weld may be achieved at reasonably fast rates of production. Welds made by this method are easily cleaned by wire brushing or by pickling.

Two other important uses of the process are derived from the excellent working properties of the molten pool. First of these is the application of heli-welding to make tacks prior to the welding with metallic arc or submerged melt. A tack made without filler is easily accomplished, and this "holding" weld is slag free and clean, as well as being flat enough so that it will not interfere with subsequent welding. This type of tacking is readily performed for fillet welds, butt joints and lap welds. The reverse process also may be used to advantage by utilizing the heli-weld to close up surface cracks and pinholes when water tightness is required in a container. A short weld run over the defect will often do the trick without the usual chipping or preheating. Naturally, this procedure is not recommended where the joint is critical because of high stress concentrations or where it is subject to highly corrosive media.

The high ductility of the heli-weld can be utilized when making joints which will be later subjected to severe forming operations, such as wiring or hemming. Figure 3 shows the top edge of a No. 20 gage pail body wired to a $^1/_8$ in. radius. The wiring is made in one press operation and the incidence of breakage or cracking is practically nil. Because of the flatness of the weld, no finishing operation was required prior to the wiring.

Inert gas welding very often is beneficial in joining the chrome nickel alloys which are susceptible to cracking. In two particular instances, we were able to reduce the incidence of defects 80% over the next best process by using inert gas. This figure was obtained in a comparative study of jobs in production, and is substantiated for the most part by other jobs in which only inert gas was used.

An ideal place to use heli-weld may be in locations where fumes are not easily exhausted. With inert gas, none of the fumes usually associated with coated stainless steel rods is encountered, and thus a weld may be made as quickly due to the operator's ability to work for longer periods. With the same thought in mind, many manual welds may be accomplished economically with heli-welding at somewhat lower speeds because of the reduction of welder fatigue.

CHOICE OF MANUAL, SEMIAUTOMATIC OR COMPLETE AUTOMATIC WELDING FOR A SPECIFIC JOB

The limitation of quantity is not the only factor to be

Fig. 3 Heli-welded pails. Note severe wiring operation

Fig. 4 Simple fixture for mechanical heli-welding

considered when deciding on the possible use of automatic heli-weld equipment. Experience shows that often it is desirable to use an automatic setup for a relatively short run, and other times manual or semiautomatic is more suitable to sizable production. The former condition often occurs where a very light gage material must be welded and ground flush. On very thin stainless steel even the most skilled operator has some difficulty in making manual welds completely free of surface defects. (In such cases, though it is seemingly impractical, it is desirable to use an automatic heli-welding on stainless steel to minimize scrap loss and finishing costs.)

As in other welding methods, an automatic process is often unfeasible though the quantity is large. This may be due, among other things, to irregular shapes, the impracticability of making close fitting parts or the lack of continuity of weld. In these instances, it is necessary to carefully evaluate the possibilities from the standpoint of setup and welding speed as well as subsequent operations. However, heli-weld's versatility for use in semiautomatic and mechanical welding process may be employed in many of these "in-between" jobs. Figure 4 is an example of the adaptability of heli-weld to a simple mechanical fixture. Note that the arc is made and maintained by applying slight pressure to the spring from which the torch is suspended. The work is rotated by hand at a rate determined by the operator who can watch the fusion because of the well-defined pool, characteristic of the inert gas process.

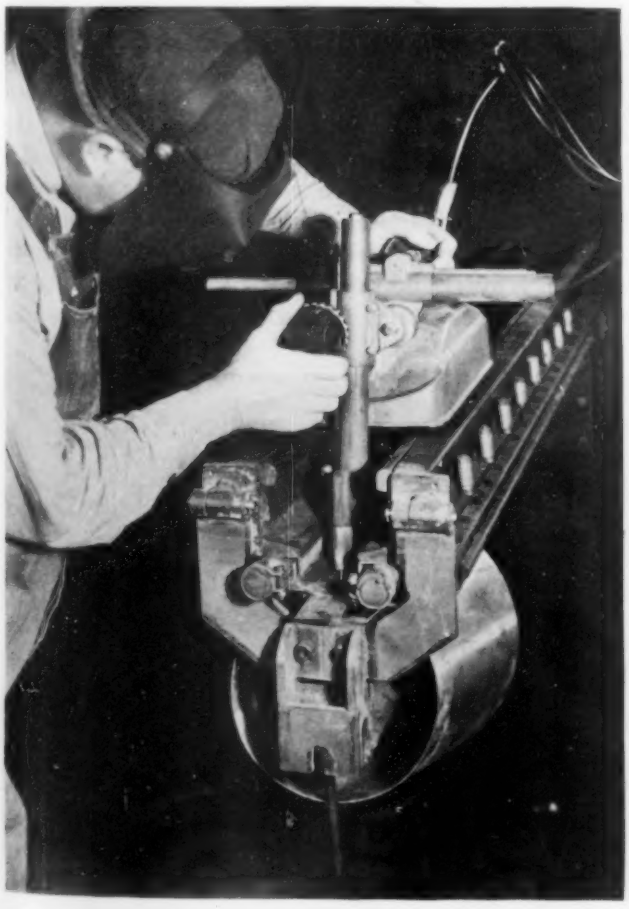


Fig. 5 Portable fixture for heli-welding straight seams

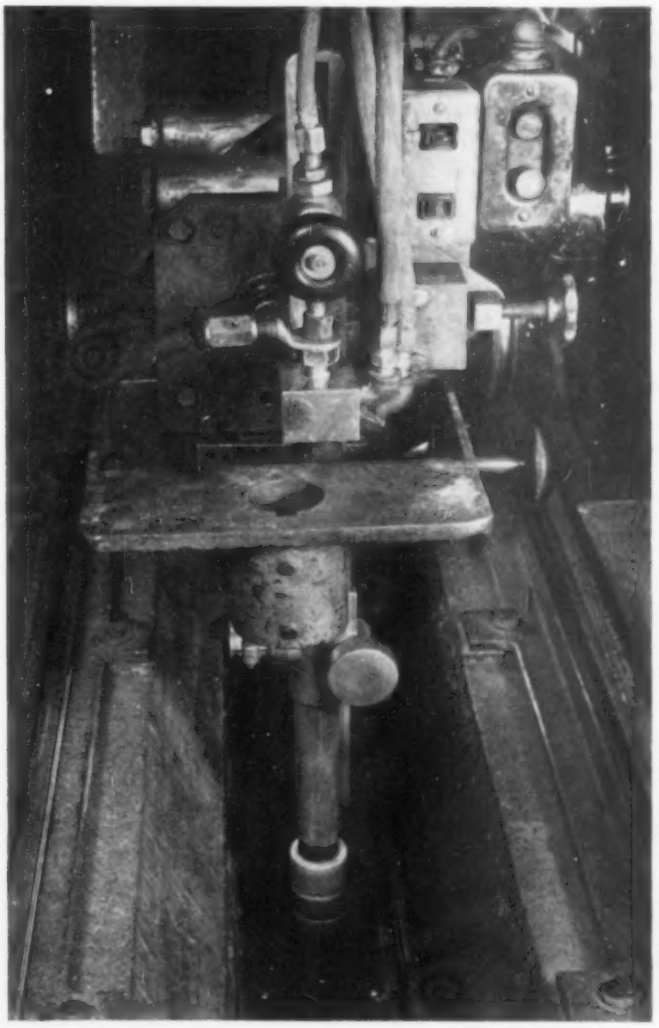


Fig. 6 Stationary heavy semiautomatic unit for straight seams

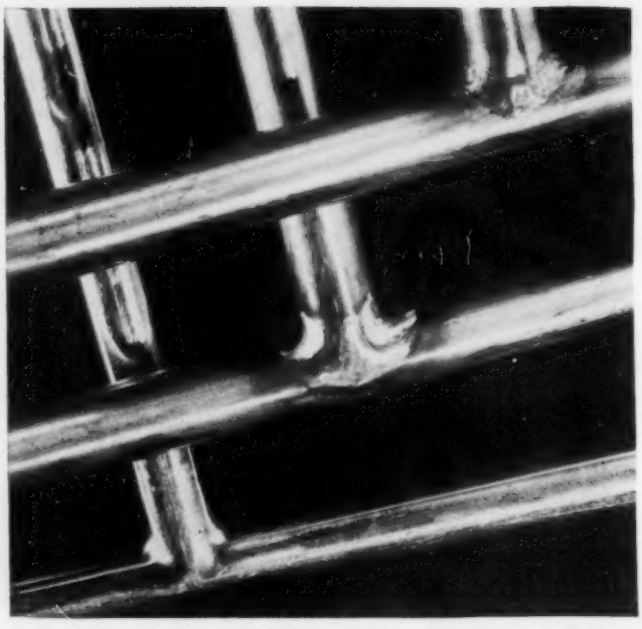


Fig. 7 Tee-weld made with carbon electrode and helium shield

Using heli-weld, the setting up of automatic equipment presents considerably less of a problem than other fusion processes. This is especially true when no filler rod is used. For general light and medium gage work, we have found a setup as shown in Fig. 5 completely satisfactory. Briefly, this consists of a helium torch mounted on a cutting mule. For heavier and more exacting work, a fixture as shown in Fig. 6 is used. Note that in both cases these units are not equipped with arc length control, and the operator starts motion by a switch closely at hand. After considerable study, we have come to the conclusion that arc length control is not always necessary for flat welding on stainless steel, but is highly desirable and often indispensable for use in circumferential welding.

TYPE OF ELECTRODE TO BE USED

In most instances, a specific job may we heli-welded using either the tungsten or carbon electrode. However, in order to attain top performance and uniformly good welds, we have found that carbon is best suited for all manual welds, as well as semiautomatic operations, where short lengths are joined, such as would be encountered in the welding of rings, bands, etc. We again except from this the weldments where severe metallurgical specifications are to be considered. In such cases, a detailed study of the particular weldment should be made. However, it is reasonably certain that after more field experience has been accumulated, the carbon electrode, which gives a more versatile performance in manual welding, will see more extensive use.

Figure 7 shows a tubular tee-weld which was made with a carbon electrode. This irregularly shaped item would be difficult to weld with tungsten because of arc blow, starting difficulties and other disturbances.

The carbon electrode may be successfully employed where backing is not practical, due to large size or unusual shape of the object welded. This is accomplished by having the weld followed with a chill bar on the penetration side. This is readily performed as the arc is easy to follow because of the lack of glare.

As previously mentioned, heli-welding has an important use for tack welding. When this operation is performed, it has been found advisable to use a carbon electrode. The carbon electrode is preferred in this instance because of its quick starting action and also its nonsticking qualities. Figure 8 shows a rack in which $^5/_{32}$-in. diam. wire has been tack welded to $^1/_8$ by 1 in. strip. Not only is the tack welding very fast, but also where a wire extended over the strip, it was possible to melt off the excess material. The appearance of the weld was such that these racks were finished by wire brushing and pickling.

The tungsten electrode finds its more important application for all types of automatic and semiautomatic heli-welding. For many applications, a carbon electrode could be used, but due to the fact that it requires frequent dressing and is susceptible to breakage when shocked, the tungsten electrode is generally preferred.

Figure 9 shows the ideal tip for both carbon and tungsten electrodes. The carbon electrode should be tapered somewhat, but never sharp. In regard to the tungsten electrode, we have found the best results are achieved by cutting the electrode square and then permitting the natural ball which occurs within the welding temperature range to form.

SPEED OF OPERATION

We have found that, in practice, speed of operation of heli-welding should be considerably lower than the maximum speed which can be obtained. While this may not hold true for the welding of mass production items, such as stainless steel tubing or stainless steel barrels, it is, nevertheless, often the case where the production is lower and the cost of a single defect may far exceed the economies gained by fast operation, and

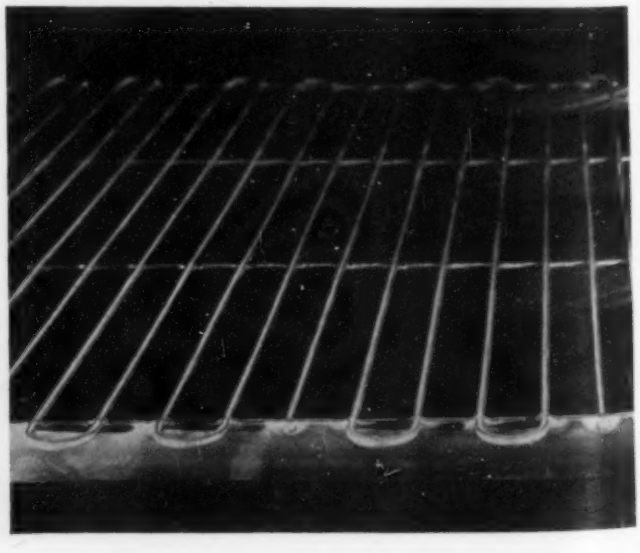


Fig. 8 Tack-welded strip and wire rack

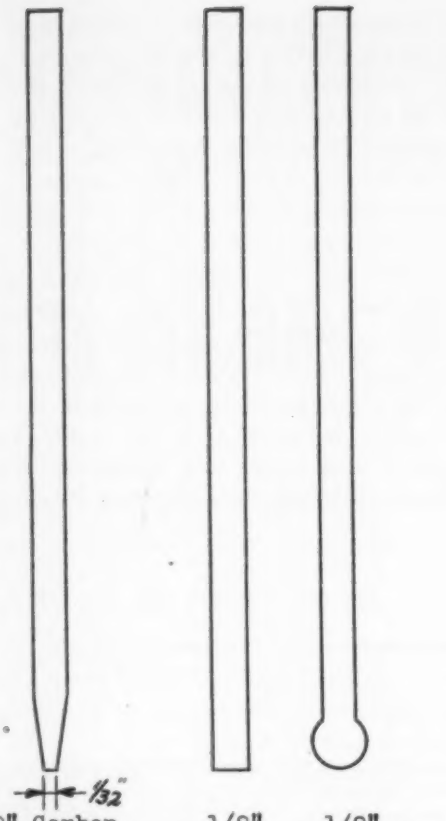


Fig. 9 Typical carbon and tungsten electrodes

furthermore, the time of setup is far greater than the welding time.

The following tables indicate some of the speeds which we have found applicable for use when a finished surface after welding was required:

Table 1

With Filler

Thickness, in.	Speed, in. per minute Min.	Max.
0.028	20	24
0.031	18	22
0.034	18	22
0.037	18	22
0.045	16	20
0.050	16	20
0.062	14	18
0.078	14	18
0.093	14	18
0.109	12	16
0.125	12	16
0.140	9	13
0.187	8	12

Table 2

Without Filler

Thickness, in.	Speed, in. per minute Min.	Max.
0.028	16	18
0.031	18	20
0.034	20	22
0.037	20	22
0.043	22	24
0.050	22	24

Although the occurrence of skips and incomplete fusion increase proportionately with the travel speed, tables 1 and 2 have proved to be a safe range.

Very often where semiautomatic equipment is used we found that welds at a very high speed will be irregular and thus difficult to finish. By welding at a lower speed the operator is in a better position to guide the path of the arc and in this manner eliminate waviness and off-centered welds.

Table 3 shows some of the manual welding speeds which have produced relatively trouble-free welds:

Table 3

Thickness, in.	Speed, in. per minute Min.	Max.
0.109	4	5
0.078	4.5	6
0.062	5	7
0.050	7	10

In regard to tables 1, 2 and 3, the choice of using maximum or minimum speed would depend upon fit-up, type of backing and the amount of penetration desired.

THE USE OF FILLER MATERIAL AND METHODS USED IN APPLYING FILLER

When heli-welding of stainless steel became more widespread directly after World War II, most practices did not include the use of filler. It was generally felt that the process should be limited to the welding of joints where no filler was needed or else where filler could be obtained in some fashion from the parts to be joined. This might be accomplished by turning up a small flange, or also by using a shearing technique which would cause a large but uniform burr. However, as the use of this process expanded it became in many cases highly desirable to add material. The principal reason for adding filler material was to eliminate depressions and undercut on the top side. Filler was necessary in many situations where finishing operation followed. The use of mechanical processes often require filler to reduce the occurrence of holes which resulted from poor fit-up and overlap. A filler material was also used to obtain additional reinforcement which is required by many welding codes.

The simplest method of applying filler may be accomplished by inserting round wire, narrow strip or shearings into the weld area, and then fusing it with the arc. Although this scheme may be utilized successfully for mechanical or manual applications, considerable thought must be given to the proper selection of size and shape.

We have found that round wire gives the most dependable results, and should be used wherever circumstances permit. Shearings may be inserted when rolled filler is not obtainable in the proper size or alloy, but should be avoided because of lack of uniformity. Although narrow strip has a tendency to shift and bow at welding temperatures, it may be of some value when a

flat, wide weld is required. For achieving the mentioned results, it is necessary to have very close fit-up.

Because of many difficulties, among which is providing an adequate and economical shield, our use of fed wire filler has been very limited. To compensate for this, we have developed a technique which includes augmenting the "laid in" filler with manually applied wire. While seemingly primitive, this technique does not materially cut down the speed of operation, and permits great versatility which is required when many different jobs and thicknesses must be welded successively on the same fixture. The filler used is of minimum diameter—good results having been obtained by adding $^1/_{32}$ in. wire for medium gages and as small as $^1/_{16}$ in. for $^3/_{16}$ in. plate.

For all manual operations, filler may be applied in the same fashion as employed in gas welding. However, we have found no particular advantage in using heliweld where a substantial quantity of material had to be added. Generally, when the diameter of filler rod exceeds the thickness to be welded, a process other than inert gas will prove more economical.

The techniques that have been described in this paper have been applied to the welding of a variety of equipment that has been used in the preparation and serving of food, the dairy, the dyeing and finishing plant, the chemical plant and the hospital. All indications are that joints welded by the inert gas process are equivalent or superior to welds made by other methods. Examination of equipment in operation in the fields mentioned above indicates that the joints welded were satisfactory to a degree that experimental predictions were borne out in regard to physical and chemical properties.

Eccentric Guides Welding Head to Make Small Circular Welds

A CIRCULAR weld, 3 in. in diameter, joins bushings to side plates in the manufacture of large-size conveyor links. The Unionmelt Type U welding head is guided in a circle by a small motor-and-gear-driven disk with an eccentric pin. The combination of the standard hinge mounting on a standard carriage with the drive gears in the freewheeling position allows the Unionmelt welding head to move in a circle when driven by the eccentric pin. For a circular mold the center of the driving pin must be directly above the welding rod (see Fig. 1).

The bushing is water-cooled to prevent drawing the temper. The knobbed covers resting on the top of each bushing connect, when in the welding location, with a foot treadle beneath the table. Pressure on the treadle makes a water-tight seal and prevents the granular Unionmelt composition and the seam from getting wet.

The weld is completed in 30 sec. By shifting the motor and eccentric pin to the other end of the slot, the welding head is swung into position to make the second weld. With this machine the operator can make 10 links (40 welds) per hour.

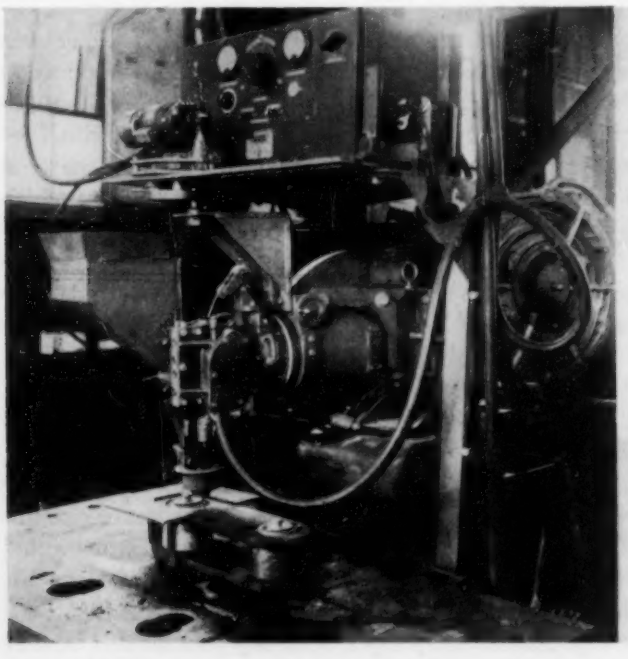


Fig. 1—12-In. Conveyor Link Ready to Be Unionmelt Welded

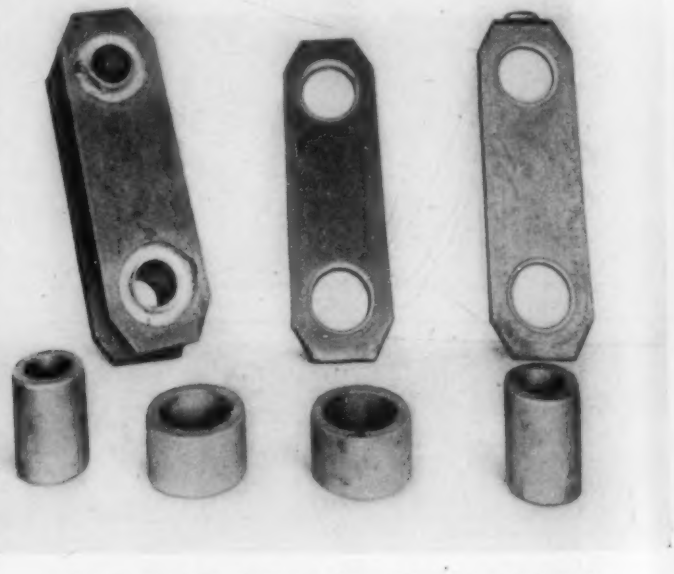


Fig. 2—Parts of the Assembly and the Completed Link

What Is the Best Way to Repair Cast Iron

A good job depends upon your choice of method

by K. H. Koopman

WHEN do you use fusion welding on broken castings and when braze welding?* Both methods for welding have advantages. To make better repair jobs you must be able to choose the best method for each casting. Here are some hints that will help you make the proper choice.

First of all you should understand the differences between braze welding and fusion welding with the oxy-acetylene process. In braze welding, the casting is not melted. Except for the area along the line of weld, the casting usually is heated to a temperature of 600 to 800° F. Heat the metal along the line of weld to about 1000° F. Because the temperature is so low, usually only local preheating is needed. Expansion and contraction stresses will not cause trouble.

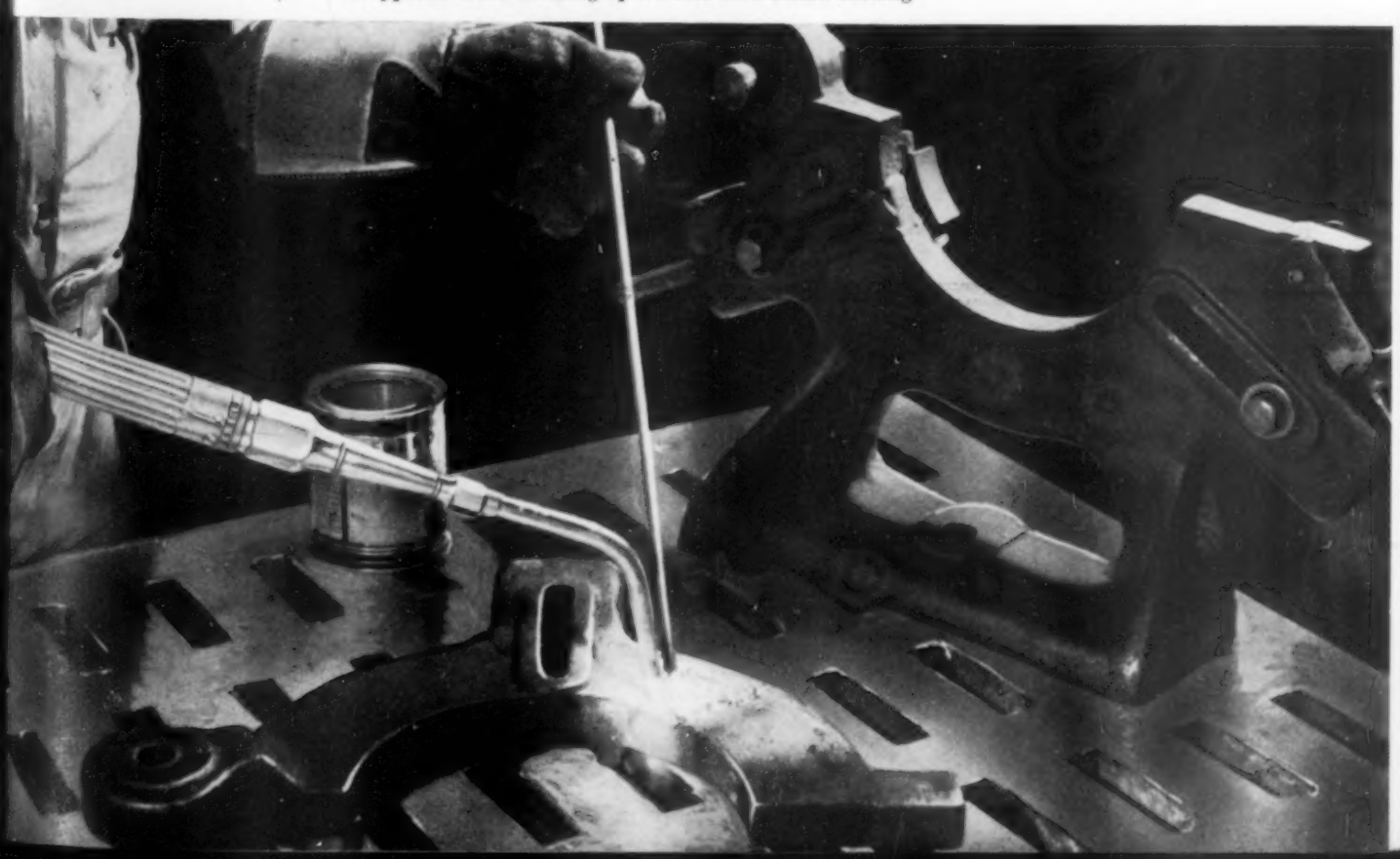
The base metal is melted in fusion welding. The beveled edges melt and the vee is filled in with molten metal from a cast-iron welding rod. A high temperature about 2200° F., is needed to melt the casting along the line of weld. You must usually preheat the rest of the casting to 1000–1200° F to prevent setting up stresses that might crack the casting later. When you fusion weld you actually recast the part in the welding groove. The weld metal has approximately the same color, composition and machining characteristics as the original part.

Whether you are braze welding or fusion welding,

Mr. Koopman is a development engineer with The Linde Air Products Co., Newark, N. J.

* Formerly called "bronze welding."

A typical braze welding operation on a small casting



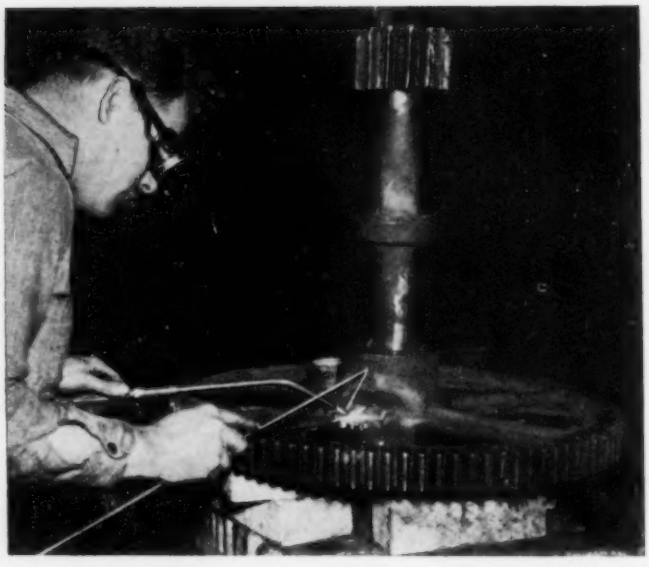


Fig. 1 This operator is braze welding a badly damaged cast-iron gear. Fourteen teeth were broken and all six spokes were cracked but the gear was back on the job in one day

prepare the joints by beveling the edges to form a 90° vee. After the welding operation, the cooling procedure is also the same. Cover large parts with asbestos paper to protect them from drafts. Bury small castings in dry sand, slaked lime, dry asbestos cement or some other insulating material. When a broken casting comes into your shop, ask yourself the following questions. Your choice between the two welding methods will depend upon the answers.

WHAT IS THE TYPE OF CAST IRON?

The first step is to identify the type of cast iron. This is important because there are three common types—white cast iron, gray cast iron and malleable iron. Specified chemical composition and special treatment during production gives each type special qualities. When molten iron is cooled rapidly, white cast iron is produced. It is hard and brittle and the fracture has a white color. White cast iron usually is used for such things as chilled rolls and chilled freight-car wheels.

Fig. 2 This casting was fusion welded because a color match was desired. The crack would have been extended by local preheating. The entire casting was preheated in a firebrick furnace

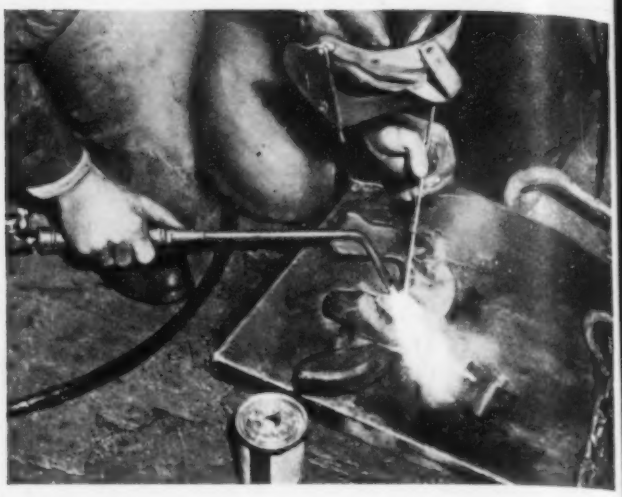


Fig. 3 There is a good business in repairing farm equipment. Here the operator is braze welding a broken grain seeder casting. Only local preheating is needed. Time required—only a few minutes

When the molten iron is cooled at a slower rate, gray iron is produced. Gray iron is softer, less brittle than white iron, and it is easy to machine. The fracture has a dark gray color.

If a casting is suitably annealed for several days at a temperature well below the melting point, malleable iron is produced. Malleable iron is ductile and can be machined easily. You can even hammer or bend thin sections somewhat without breaking them. It is used for such things as pipe fittings, farm equipment, household hardware, brackets, lugs, ratchets and all kinds of machinery.

Fig. 4 Size makes little difference. Four cracked spokes on the 7-ft. chipper wheel were repaired by braze welding. The wheel was covered with asbestos paper then preheated. All the welding was done through openings in the paper. Time required—15 hr.

Knowing the type of cast iron will help you to determine the welding method. Here's why. Welds in white iron usually are not satisfactory. Unless the part is specially treated after welding it will lose its wear resistance at the weld. You will not run across this type of casting very often, but if you must weld a white iron casting, use fusion welding with a welding rod similar to the base metal in chemical composition.

You can either fusion weld or braze weld gray iron castings. The need for a color match, and the temperature at which the part will be used, will influence your choice. Always braze weld malleable iron. The heat of fusion welding would destroy the malleability and make the casting brittle. However some castings have been fusion welded with a white iron rod and then heat treated to a malleable iron microstructure.

The chart will help you to identify the types of castings. When you use these tests always make more than one. This is the reason. The spark test alone will not show the difference between white and gray iron. However, if you examine freshly broken pieces, you will see the difference at once.

WHAT ARE THE SERVICE CONDITIONS?

Temperature: Where the parts are to operate at temperatures under 500° F., fusion welding or braze welding will be equally satisfactory. However, bronze loses strength rapidly at temperatures over 500° F. When the part will be heated in service to this temperature or higher, use only fusion welding.

Color: When a gray iron casting breaks and a color match is important, you must fusion weld.

Previous Use: Fusion welding is also the best method for repairing "poisoned" castings, such as oil-soaked machinery and brine-soaked castings.

WHAT IS THE FINISHING OPERATION?

When you will machine, tap or thread the casting in the weld, fusion welding usually is preferable. Use the same method when the casting will be enameled or glass-coated. However, when you rebuild and then shape gear teeth, braze welding is the way to do the job.

WHAT PREHEATING FACILITIES ARE AVAILABLE?

Usually you should preheat the entire part in a furnace when you fusion weld. Otherwise the high heat at the weld zone and the low temperature of the rest of the casting will set up stresses and cause new cracks. Therefore, you must build a preheat furnace. Whenever it is impossible to build a furnace, you can use your blowpipe for local preheating and do the job by braze welding.

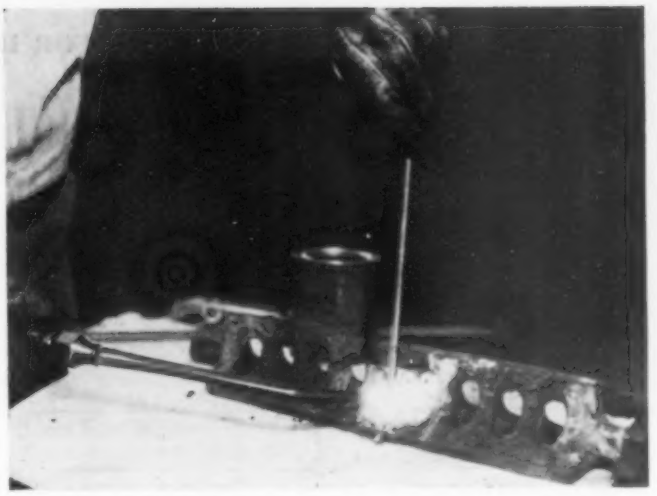


Fig. 5 Repair castings like this broken grate bar by fusion welding. Braze welds lose strength when they are heated above 500° F. Fusion weld "poisoned" castings like oil-soaked or brine-soaked castings

TWO TYPICAL JOBS

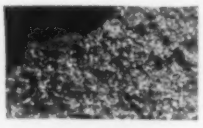
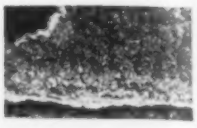
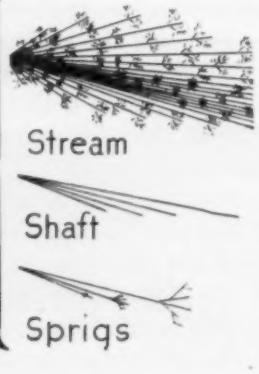
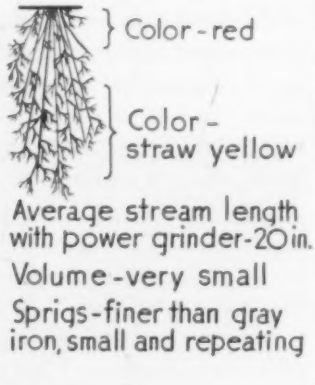
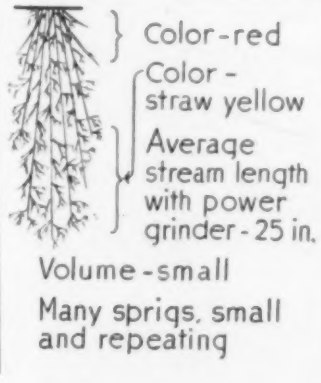
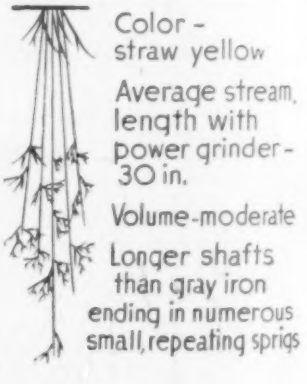
Here are two typical repair jobs—one was braze welded and the other fusion welded. They show you why the welding method was chosen and how the job was done. Figure 1 shows the operator braze welding a reducing gear for a steam shovel. Fourteen teeth were broken and all spokes were cracked. The spokes were cracked close to the shaft, in such a way that the gear could not be removed. Braze welding was decided upon for two reasons. First, the gear was needed in a hurry and braze welding is faster because it takes less preheating and the bronze weld metal melts faster at a lower temperature. Second, it would have been necessary to preheat both the shaft and gear for fusion welding and it was impractical to build a furnace to do this job.

This is how the welding was done. Two opposite spokes were ground on each side. Sections that could not be reached with the grinding wheel were chiseled. The operator then aligned the gear and the shaft and tack welded the two spokes with bronze welding rod. After the rest of the spokes were ground on both sides all the spokes were braze welded. The broken gear teeth were then ground and rebuilt with bronze.

Figure 2 shows the operator fusion welding a broken gear case. Tests showed that the part was gray iron. As you can see in the photograph the crack on the top of the casting was Y-shaped. It would have spread farther under local preheating, and in addition a color match was desired. Therefore, the secret of a successful job was to preheat the entire casting and do the repair by fusion welding. With full preheating, bronze welding could have been used, and the preheat temperature could have been lower if a color match had not been required.

The cracks were ground and a temporary firebrick furnace was built. The casting was placed in position and preheated by a charcoal fire. (See August 1948, WELDING JOURNAL for instructions for building firebrick furnaces.) Welding was started when the temperature

SIMPLE TESTS FOR IDENTIFYING CAST IRONS

	What to Notice	White Cast Iron	Gray Cast Iron	Malleable Iron
APPEARANCE	FRACTURE	Very fine silvery-white silky crystalline formation. Will not smudge finger	 Dark gray; will smudge finger	 Dark gray except for lighter outer layer
	UNFINISHED SURFACE	Evidence of sand mold; dull gray	Evidence of sand mold; very dull gray	Evidence of sand mold; dull gray
	NEWLY MACHINED SURFACE	Rarely machined. Difficult to machine or file	Fairly smooth; light gray	Smooth surface; light gray
CHIP TEST	DUCTILITY	Brittle, breaks without bending	Brittle, breaks without bending	Can be bent moderately
	APPEARANCE OF CHIP	Small broken fragments	Small partially broken chips but possible to chip a fairly smooth groove	Chips do not break short as in cast iron
	SIZE OF CHIP	——	1/8 in.	1/4–3/8 in.
	FACILITY OF CHIPPING	Brittleness prevents chipping a path with smooth sides	Not easy to chip because chips break off from base metal	Very tough, therefore harder to chip than cast iron
BLOWPIPE TEST	COLOR CHANGE WHILE HEATING	Becomes dull red before melting	Becomes dull red before melting	Becomes red before melting
	APPEARANCE OF SLAG	A medium film develops	A thick film develops	A medium film develops
	APPEARANCE OF MOLTEN PUDDLE	Fluid and watery; reddish white	Fluid and watery; reddish white	Fluid and watery; straw color
	ACTION OF MOLTEN PUDDLE UNDER BLOWPIPE FLAME	Quiet; no sparks; depression under flame disappears when flame is removed	Quiet; no sparks; depression under flame disappears when flame is removed	Boils and leaves blowholes; surface metal sparks; interior does not
SPARK TEST		 Color - red Color - straw yellow Average stream length with power grinder - 20 in. Volume - very small Sprigs - finer than gray iron, small and repeating	 Color - red Color - straw yellow Average stream length with power grinder - 25 in. Volume - small Many sprigs, small and repeating	 Color - straw yellow Average stream length with power grinder - 30 in. Volume - moderate Longer shafts than gray iron ending in numerous small, repeating sprigs

reached 600° F. The branches of the "Y" were welded first and then the "tail." As soon as the weld was completed, the top of the furnace was completely covered with asbestos. The fire was then left to burn itself out and the casting was not moved until it was completely cold.

Take Care of Small Castings

by H. B. Gilson

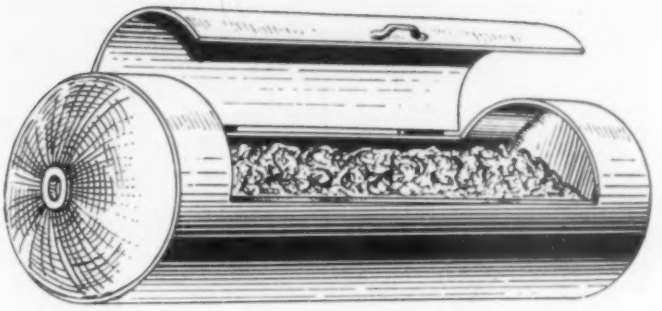
DONT treat small castings like poor relations. Large castings that need preheating before welding are not the only ones that should be cooled slowly and carefully. Small castings are subject to internal strain just as much as large ones. You will find that the most convenient and efficient way to cool small castings slowly is in an annealing bin.

HOW TO MAKE IT

You can make an annealing bin in just a few minutes time from an old cylindrical storage tank. Or you can use old range boilers, and old tanks from a hot water heater. When these items are not available you can use your welding blowpipe to construct a bin from sheet metal. The size and shape will depend upon the materials you have on hand.

With your cutting blowpipe, cut a section out of the side of the tank. Be sure to observe the approved safety practices for welding and cutting on containers. Hinge the cut-out section back in place to serve as a lid, as shown in the sketch.

Mr. Gilson is a development engineer with The Linde Air Products Co., New York, N. Y.



Here is an annealing bin that can be made from an old storage tank. Simply cut and hinge a section of the side

INSULATION MATERIAL

Do not throw away the old asbestos paper you use to protect large preheated castings. Tear it into small pieces and put it into the annealing bin. The paper makes an excellent insulation material for slow cooling of hot castings. It will not cost anything because you have already used it two or three times. Slaked lime is another inexpensive insulator that is also easy to handle.

Another Easy Job for Your Blowpipe

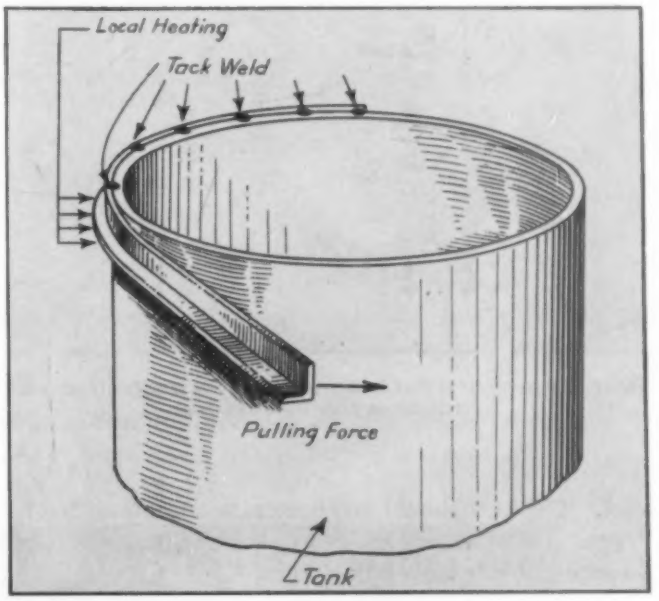
Use it to heat metal for bending, straightening and forming

by I. Kurzinski

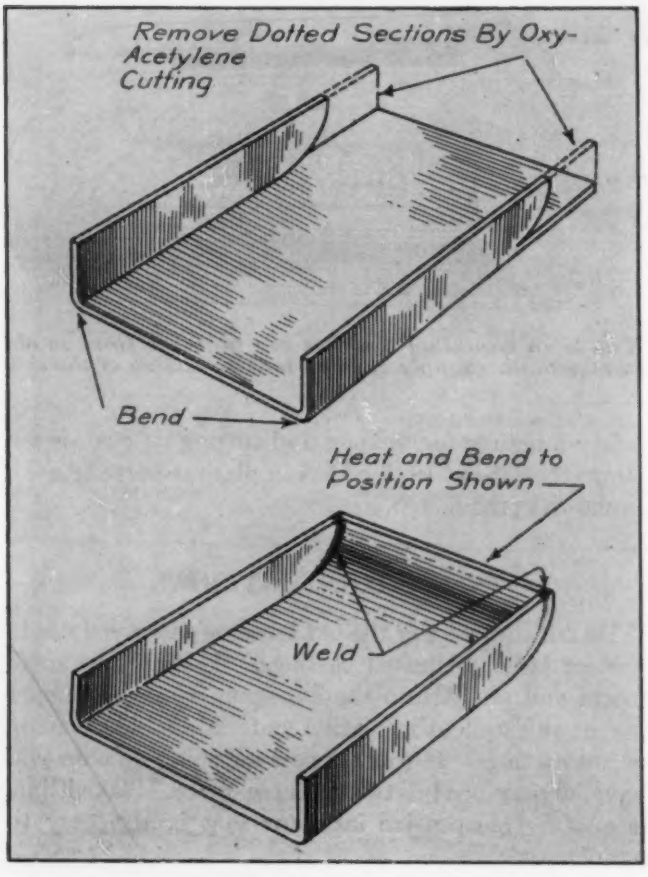
BENDING and straightening metals depends on the fact that metals expand and contract as the temperature changes. When a section is heated it will expand. It will try to contract to its original size and shape when it cools. However, the expansion may be held back by another part of the structure or by the cold metal adjacent to the heated area.

If this happens, the heated metal will upset and become thicker than it was when cold. As the heated area cools, it will try to contract to the original size and shape and will change the shape of the rest of the part. To take full advantage of this property for straightening or bending metal parts you need a quick heat. The heat must be applied rapidly so that the heated area becomes a dull red while the surrounding metal stays

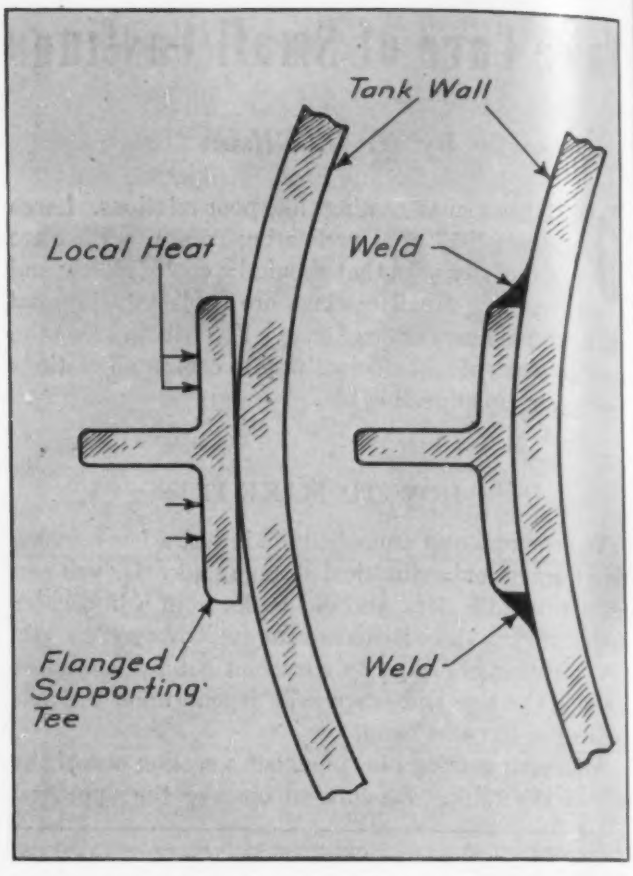
Mr. Kurzinski is a development engineer with The Linde Air Products Co., New York, N. Y.



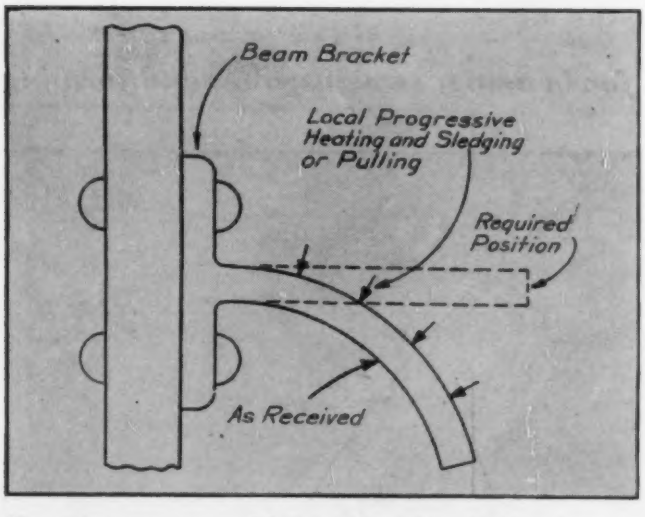
This sketch shows how to form and weld angle iron on things like pipe or tanks. Use the same blowpipe and flame adjustment for heating and welding



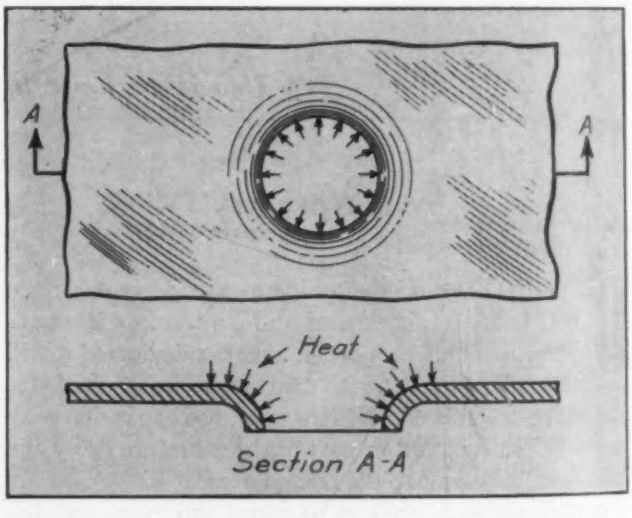
Use cutting and welding blowpipes to form a shape like this from a piece of sheet steel. It is easy to bend, straighten or form metals



Supporting tees can be formed to fit the outer wall of a curved part by heating. Then weld it in position with the same blowpipe



Heat the arm to a red heat and apply a pulling force to straighten this bracket arm



A flange can be formed by heating the entire area and then forging it to the shape desired

cool. The heat should not penetrate more than $^1/_{16}$ to $^1/_8$ in. If the heat is allowed to soak in, you will need to apply additional bending power.

You have a fast, economical heat source in your welding blowpipe. You can apply the intense heat just where you need it and you can easily control the amount. The accompanying sketches illustrate some common heating jobs. You can learn from them where and how to use the oxyacetylene heating flame to get the best results. You can adapt these basic operations to almost any bending, straightening or forming job that comes to the shop.

Tough where it has to be Tough

Comfortable Protection for Welders' Hands

Made from selected chrome-tanned cowhide leather, the TX100 is one of the best welding gloves ever developed. It gives long, hard wear on the toughest jobs. Its outstanding construction features include — (1) One piece back that eliminates all unnecessary seams and prolongs glove life; (2) Double thickness of leather on thumb and forefinger for extra serviceability; (3) Lining on back of glove from wrist to fingertips to prevent chafing, absorb perspiration and give added protection. Order today from your AO Safety Representative.

American Optical
COMPANY
Safety Division

BRANCHES IN PRINCIPAL CITIES • SOUTHBRIDGE, MASSACHUSETTS

the AMERICAN WELDING SOCIETY

activities • related events

Annual Report of Executive Secretary

Our SOCIETY closes its 1947–48 administrative year with many gains and some losses. Our gains are those of stronger national morale; far greater knowledge of our field operations and potential; expanded and ever-increasing national headquarters activity; three new sections opened and in operation and a number of new sections and section-divisions in the organization stage. Our losses consisted of a small drop in membership and in finances. This financial loss, to its greater extent, represents the cost of attaining the cited gains. We submit to you, gentlemen, that it was a required investment.

Among, or in addition to, the year's major accomplishments, which will be hereinafter cited by the reporting chairmen or secretaries of our various and active committees, are the following in which the executive secretary has had the pleasure of participation or direct interest: Total section visitation by national officers; decision to gradually modify THE WELDING JOURNAL; greatly improved format, content and index of the next (3rd) edition of the *Welding Handbook*; geographical sectional expansion; expansion of our educational committee activities; occupational poll of our national membership; institution of standard national membership campaign pattern; institution of a new vehicle, the "Section Advisory Service," for dissemination of instructional, operational and educational material to section officers.

Without question the institution of a policy of annual section visitation by at least one headquarters officer has resulted in lifting our morale sectionally and nationally. The problems of both section and national headquarters become clearer and are more capable of solution. An atmosphere of mutual appreciation, understanding and cooperation is created and will be maintained by continuation of this program. Greater activity is planned for the coming year. The newly elected National Officers, G. N. Sieger, President, O. B. J. Fraser, First Vice-President and H. W. Pierce, Second Vice-President, plan an active year of section visitation. This will allow the executive secretary additional time for the development of new sections and section expansion.

Too frequently we do not know ourselves as we really are. Limited personnel and other restrictions in the past have prevented our SOCIETY'S studying itself. During the past year we have studied and gained knowledge of our weak spots—geographically, industrially and internally. We now know the occupational distribution of our membership and are aware of the direction in which our greater efforts must be expended and expanded. We now know where and how we must modify or amplify our services to accommodate, representatively and proportionately, our membership as is, and as such we hope to obtain. We have been consolidating our position and now are poised for an active year of effort, campaign and expansion.

Total section visitation has resulted in our learning what services our sections require and where, when and how national headquarters can assist them. As a direct result a new activity has been instituted and is known as the "Section Advisory Service." It comprehends a number of the services provided in the past by headquarters but now greatly expanded. It provides a vehicle for the dissemination of data, aids, bulletins, advices, instructions, surveys and other valuable services to the sections. Over a period of time it will treat with the following section activities; management and officer duties, program, speaker selection, meetings and arrangements, membership activities, education, plant visitation, annual symposiums, publicity, entertainment and dinners, prizes and awards, industrial motion pictures, section aids, finance, organization of section divisions and new sections and other activities as they develop. After ample study the pattern for this service has evolved and it was instituted August 16th past. Heavy releases have been issued in several of its departments. It will progressively equip our section officers for managing their sections and conducting their activities with the maximum efficiency.

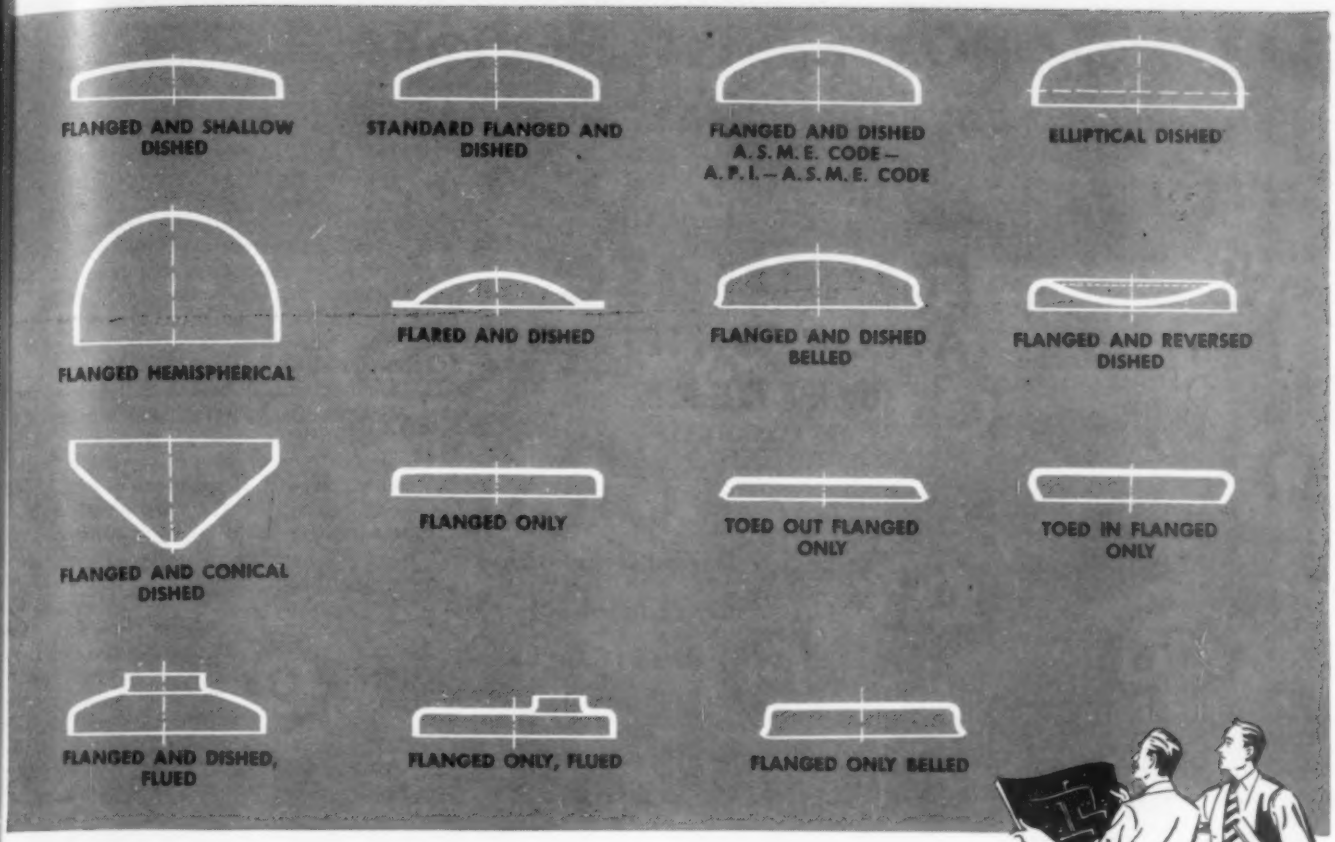
During the past administrative year your executive secretary visited all sections in the States at least once, meeting with the officers and executive committees of these sections. He made 87 calls upon various industrial plants, manufacturers and others interested in the SOCIETY'S activities. He visited nine additional communities, not then A.W.S. section centers, for the purpose of exploring their possibilities for new section activity. Three new sections have been officially opened; the Tri-State Section at Evansville, Ind., Anthony Wayne Section at Fort Wayne, Ind., and the Nashville Section at Nashville, Tenn. The greater credit by far for these new section activations belongs to the District Vice-President and the officers of the surrounding assisting sections. There soon will be an official section or section-division at Wilkes-Barre, Pa., a section-division at Duluth, Minn., and a section-division at Olean, N.Y.

We are planning on developing new sections as soon as possible at Omaha, Neb.; Urbana or Decatur, Ill.; Beaumont, Tex.; Dallas, Tex.; Phoenix, Ariz., Beloit, Wis.; Appleton, Wis.; Davenport, Ia.; Roanoke, Va.; Charleston, W. Va. Also are working on the development of section-divisions at Topeka, Kans., and Joplin, Mo.; Kalamazoo, Mich.; Richmond, Va.; Mobile, Ala.; Baton Rouge, La. and Utica, N.Y. The additional centers of Shreveport, La.; El Paso, Tex.; Duncan, Okla.; Hagerstown, Md.; Bakersfield, Calif.; Stockton, Calif.; North Richmond, Wash., and little Rock, Ark. have indicated interest in a SOCIETY activity.

During the past year a large number of our sections were most fortunate in receiving visits from our National Officers. Our President, H. O. Hill, visited the St. Louis, Philadelphia, Lehigh Valley, Boston, Pittsburgh, Buffalo, Minneapolis, Hartford and Washington, D. C., Sections, the Wilkes-Barre, Pa., potential section area and student groups at Lafayette and Penn State Colleges. G. N. Sieger's, First Vice-President, visits included the Grand Rapids, Saginaw Valley, Cleveland and Detroit Sections. His illness, starting in January, curtailed plans for further section visitation. And the Colorado, Chicago, Cleveland, Detroit and Washington, D. C., Sections were visited by O. B. J. Fraser, Second Vice-President. As observed in later individual reports, our District Vice-Presidents were very active in section visitations. In most instances our National Officers not only addressed the membership at the section meeting but, also, met with the Section Officers and Executive Committee for discussion of section and national problems.

During the past year several of our sections conducted membership campaigns that were quite productive and the national SOCIETY'S congratulations and appreciation is hereby extended to them. But, due to several reasons, one being the almost total "field" activity of the executive secretary, no over-all national effort for new membership ensued. Therefore, considering that the year has been without an over-all national membership campaign, the smallness of our membership loss as experienced this past year is actually encouraging. But this new 1948–49 season must be approached with determination that as many answers as possible be found

(*Continued on page 962*)



If the job calls for *Heads*

. . . you can get them from Lukens

Every Shape and Style

Look at the variety of heads produced by Lukens; every shape and style you can possibly need. And when you are designing tanks, pressure vessels or other equipment requiring heads, look in Lukens Catalog No. 1 for standard heads to handle the job.

Small and Large Sizes

Lukens makes heads as small as four inches and to over twenty feet in diameter. Heads as thick as six inches are also made by Lukens Steel Company.

In All Commercial Metals

Heads are made of carbon and alloy steels, including stainless, of nonferrous metals and the widest selection of clad steels available anywhere. Select the metal that will do your job best and Lukens will make the heads.

Many Standard and ASME carbon steel heads are in stock ready for prompt shipment. For other styles and sizes, Lukens has hundreds of dies with which to produce them. For a quotation on your head requirements, write Lukens Steel Company, 407 Lukens Building, Coatesville, Pennsylvania.

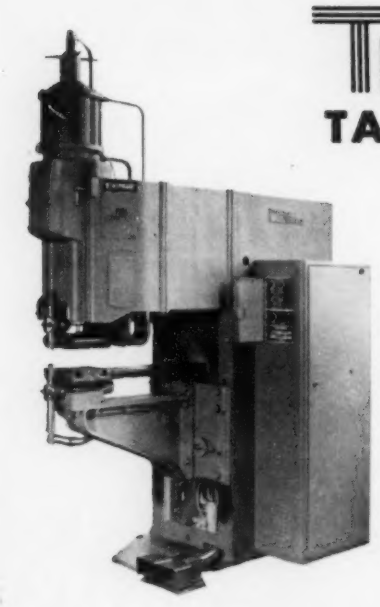
LUKENS
HEADS
★

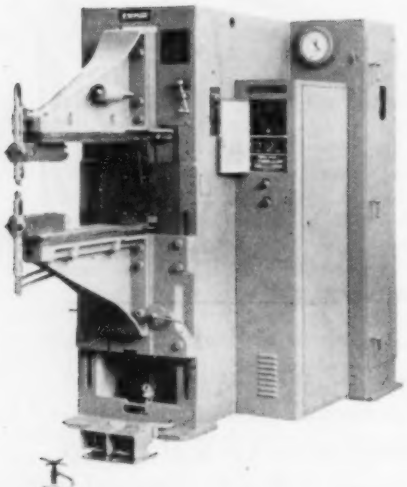
. . . of interest to you . . ***"HEAD WORK"****, a 16mm motion picture in sound and color, on spinning and pressing of Lukens Heads is available without charge. Running time: 27 minutes. Write for a booking date.*

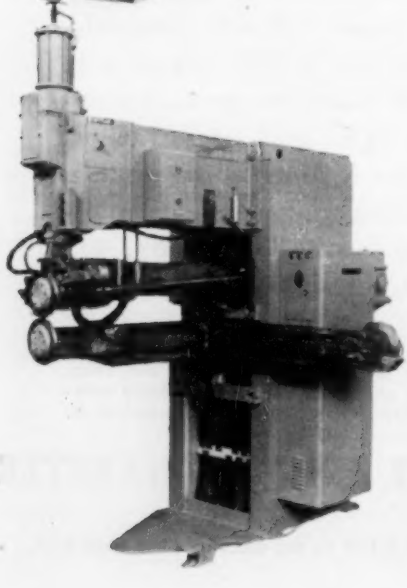
FOUR INCHES TO OVER TWENTY FEET IN DIAMETER

• • SPEED SCRAP TO THE MILLS TO MAKE MORE STEEL • •

95% POWER FACTOR
BALANCED THREE PHASE
WITH
Tri-Phase
TAYLOR-WINFIELD
WELDERS
(RESISTANCE)







Six Highly Desirable Features . . . (1) greatly reduced power demand; (2) three phase balanced power load; (3) desirable high power factor (95%); (4) improved weldability; (5) deeper throat depths with essentially no increase in power demand; (6) with Tri-Phase, you can weld low carbon steel, stainless steel, aluminum alloys, magnesium, Monel, Inconel, brass alloys, and other materials on same welder.

Tri-Phase can be had in spot, projection, seam, or upset-butt welders. Ask for Tri-Phase Bulletin 10-813 just off the press.

THE TAYLOR-WINFIELD CORPORATION
WARREN, OHIO, U.S.A.

TAYLOR-WINFIELD
RESISTANCE WELDERS

(*Continued from page 958*)

for regaining our "lost," holding our "present" and gaining many "new" members. We will need the coordinated help of every National and Sectional Officer and Member. All of us must be active membership committeemen.

A standard national membership campaign plan was released September 9th, past, to all Sections. It was flexibly prepared for conducting the campaign any time during September, October or November. The plan is but suggestive. It is wholly possible that some Sections will prefer plans that, in their experience, are more aptly patterned to fit their local conditions. Each section will know best how to plan its campaign. Regardless of the plan pattern adopted it is essential that all of the present Membership in each of our Sections support their section officers and committeemen in expending every effort toward doubling each Section's membership.

During the coming year, by means of a new institutional type brochure, the SOCIETY will acquaint industrial executive management with the part your AMERICAN WELDING SOCIETY has played since 1919 in the building, the educating, the strengthening and the servicing of the welding industry. Through this publicity it will enlist industry's moral and financial support of the SOCIETY'S activities, sectionally and nationally. This program will require the total cooperation of the Section Officers and Executive Committees.

Our ultimate objective is to increase our total membership to 15,000 as soon as such can be accomplished. Our immediate objective is to raise our total membership as much as possible before the close of this year, 1948. It is essential that our SOCIETY increase its membership in the order cited so that it can expand its activities to provide the many additional services that are being requested of it by its Members, its Section Officers and Industry. Unified sectional and national effort during the coming year should result in those achievements all of us so earnestly desire.

The executive secretary extends his sincerest appreciation to the President and Board of Directors, all National and Staff Officers, Committee Chairmen and Members, Section Officers and Members for their cooperation and assistance during the past year. Without their support the accomplishments cited could not have occurred.

J. G. MAGRATH

Sustaining member

United Wire & Supply Corp. Providence 7, R. I. was established in 1869.

The company produces a full line of low-temperature brazing alloys, materials and supplies. Silver alloys are produced in a diversification of standard compositions. Their new laboratory-developed Phosco, a copper-phosphorus alloy for brazing the coppers, bronzes and brasses, is a highly successful substitute for low-silver brazing alloys and available at one-third the cost of such materials. As the result of extensive laboratory research and development, their Sil-Flux is an excellent brazing flux for all low-temperature brazing.

CONSULT WITH RESISTANCE WELDING ELECTRODE HEADQUARTERS

Die Design and Engineering Service

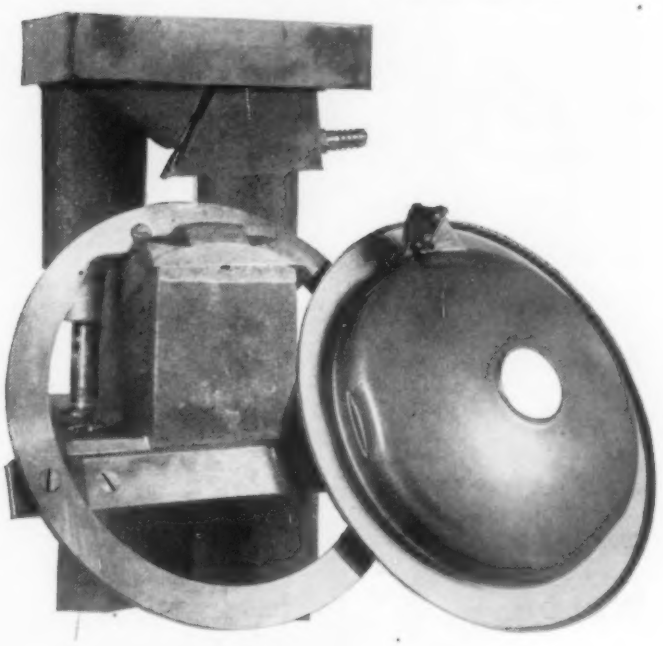
You send us this . . .

the actual parts,* like these two metal stampings a manufacturer was having trouble joining.

**Prints, if parts are not available.*

We furnish this . . .

A die design that will handle the job . . . built to exacting Mallory specifications using the proper combinations of Mallory alloys, for long life.



Mass Production—Job Simplification—those are key words in resistance welding. Mallory Resistance Welding Engineers know well how to work out die and fixture designs that will pay off in terms of motion saved and production speeded.

The Mallory crew of tool and die makers cannot be matched anywhere in the industry. They have the finest machine tools to work with and they thoroughly understand the special properties of each Mallory alloy. The combination of skill, experience and tools assures you finished dies that will get your job into production quickly and smoothly.

Mallory's trailblazing experimental work over 20 years in electrodes, holders, dies and fixtures represents the most substantial contribution made by any manufacturer of those components to the present—and the future—of Resistance Welding.

SEND YOUR SPECIAL DIE PROBLEMS TO MALLORY, AND BE SURE!

In the United Kingdom, made and sold by MALLORY METALLURGICAL PRODUCTS LTD. (An Associate of Johnson, Matthey & Co., Limited), Hatton Garden, London, E. C. 1.

RWMA

THE PIONEERS OF ELKONITE*, ELKALOY A*, MALLORY 3*, MALLORY 53B and MALLORY 100 METALS.

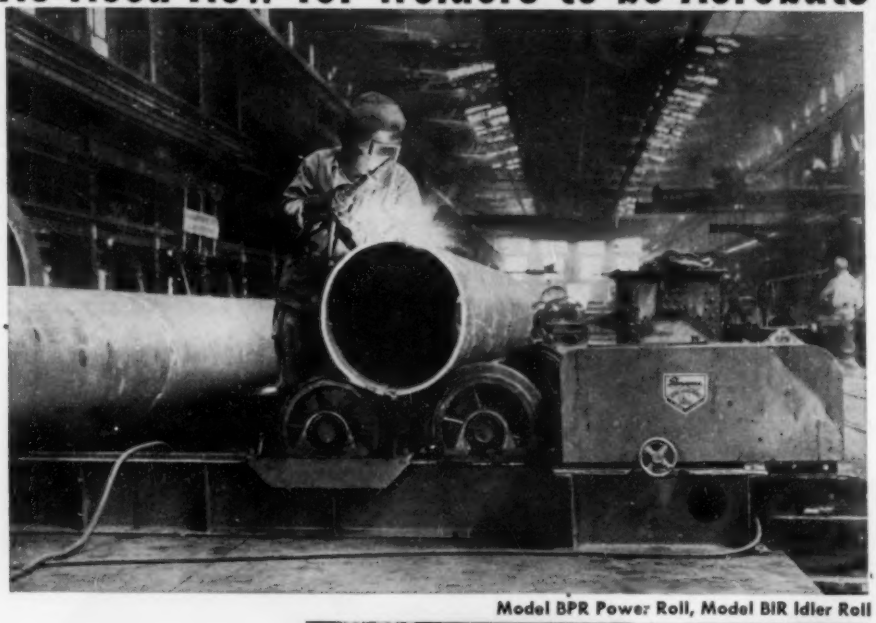
P. R. MALLORY & CO Inc

MALLORY RESISTANCE WELDING MATERIALS

ELECTRODES—HOLDERS—SPECIAL DIES AND FIXTURES—
ELKONITE* METALS—ALLOY ROD AND BAR STOCK—
FORGINGS—CASTINGS—ACCESSORIES *REG. U. S. PAT. OFF.

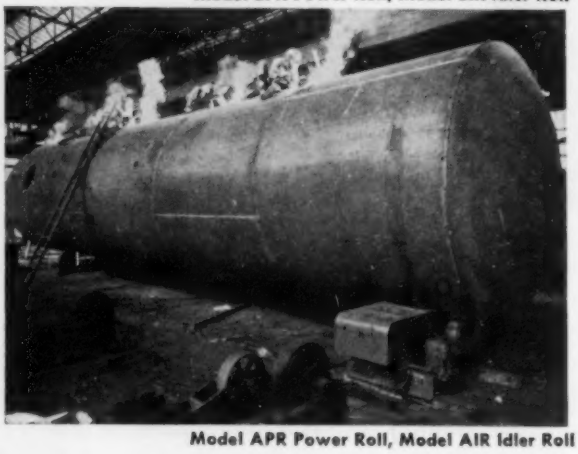
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

No Need Now for Welders to be Acrobats



Model BPR Power Roll, Model BIR Idler Roll

MORE PRODUCTION AND BETTER WELDS WITH



Model APR Power Roll, Model AIR Idler Roll

Ransome TURNING ROLLS

Welders can make all welds "down hand" with heavier electrodes when Ransome Turning Rolls bring the work into convenient working position for *increased production* and *neater, better welds.*

The improved Ransome line includes three models, with standard capacities from 3 to 45 tons, up to 14 feet in diameter, stationary or self-propelled. (Rolls for heavier or larger work also available.)

Ransome features for trouble-free operation: *unobstructed loading* from either end, due to lowered drive mechanism • *easy rotation* under heavy load, due to anti-friction self-aligning bearings (Models B, C) • *strength where most needed*—exclusive combination bronze and steel reinforced worm wheel • *quick adjustment* for varying diameters • *adjustable variable speed rotation.*

Send coupon for bulletin.

INDUSTRIAL DIVISION

Ransome MACHINERY COMPANY

DUNELLEN, NEW JERSEY

A SUBSIDIARY OF

WORTHINGTON PUMP AND MACHINERY CORPORATION

PRODUCTION UP 50% LABOR COSTS DOWN

TURNING ROLLS

WELDING POSITIONERS

Ransome Machinery Company
Dunellen, N. J.

Please send Bulletin 228-2 on Ransome Turning Rolls.

Name.....

Company.....

Address.....

YE-7

The company also manufactures brass mill products including all types of seamless nonferrous metal tubing including, but not limited to copper, brass, bronze, nickel alloys and aluminum. Also, drawn wire in the fine sizes in all nonferrous metals.

Membership Drive

A national membership drive patterned after a successful Milwaukee plan which resulted in doubling the membership of that Section has been launched by the Society and its 54 local sections. The goal is 15,000 members. The drive will terminate December 6th. Each Section will put on an intensive 10-day drive. Some 30 days of careful preparation is required before the drive can be launched. The preparation involves publicity, team organization, literature, squad formations, etc. Each step is carefully planned and coordinated. Every member can help by playing the part for which he is called upon to act.

Resistance Welding Awards Announced by American Welding Society

The American Welding Society announces the awarding of $2000 in prizes to the winners of the 1948 Resistance Welder Manufacturers' Assn. Contest. The prizes are awarded annually to the authors of papers which cover significant and original achievements in the field of resistance welding. Three awards totalling $1500 are made to authors in industry; two awards totalling $500 are made to authors in universities or colleges.

First prize of $750 for the best paper from an industrial source has been awarded to Frank G. Harkins, Welding Engineer, Solar Aircraft Co., San Diego, Calif., for his paper entitled "Spot Welding Schedules for Nickel and Nickel Alloys."

Three engineers with the Taylor-Winfield Corp., Warren, Ohio, have been selected as winners of the second and third industrial prizes of $500 and $250 respectively. R. C. Jones, Sales Engineer, won the second prize with his paper entitled "Resistance Welding Crossed Wires." C. E. Smith, Chief Electrical Engineer, and R. H. Blair, Research Engineer, are co-authors of the third best paper on the subject of "Resistance Welding Characteristics of the Dry Disk Rectifier Welder."

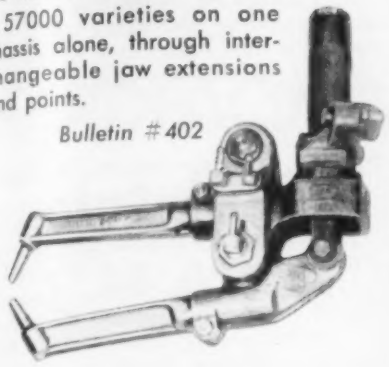
Three metallurgical scientists at the Rensselaer Polytechnic Institute, Troy, N. Y., collaborated in winning the two prizes awarded to papers originating at universities. Prof. W. F. Hess, Head of the Department of Metallurgical Engineering, and Dr. W. J. Childs and Dr. W. D. Doty, Research Fellows, won $300 as co-authors of the best paper entitled "The Heat Treatment of Spot Welds in Steel Plate." Dr. Childs is now a member of the research staff at the Massachusetts Institute of Technology, Cambridge, Mass. and Dr. Doty is Welding Metallurgist, Research and Development Div., Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

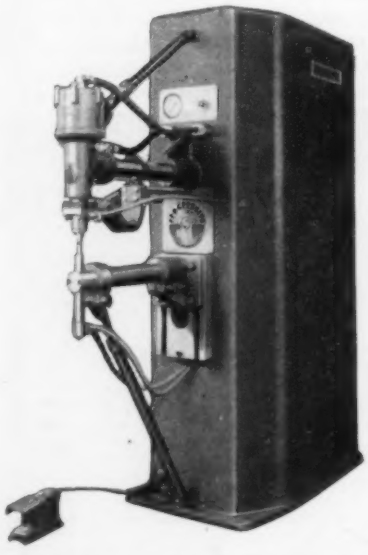
Dr. Hess and Dr. Childs also won the second prize of $200 with their paper entitled "A Study of Projection Welding."

STANDARDIZED GUNS

57000 varieties on one chassis alone, through interchangeable jaw extensions and points.

Bulletin #402

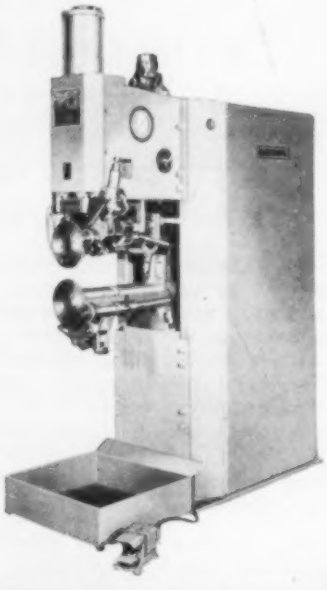




PEDESTAL SPOT WELDER

The "universal" spot welder. Built to take it, and how! Quickly adjusted to a variety of jobs.

Bulletin #503



ROLLER HEAD SEAM WELDERS

Another Progressive "first." The roller head follows changes in metal thickness uncannily. You can seam weld faster and better.

Bulletin #804

STANDARD EQUIPMENT *that takes the guesswork out of* RESISTANCE WELDING

Here are seven reasons why Progressive today is the largest supplier of resistance welding equipment to industry.

•

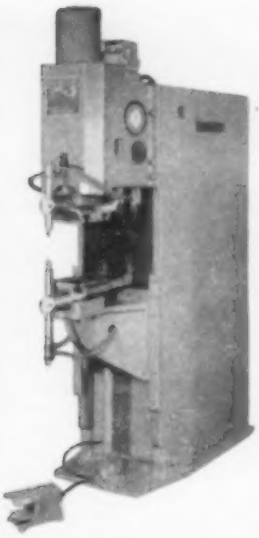
Plus Progressive Special Machines for practically any resistance welding need

IT PAYS TO WELD

PROGRESSIVE

WELDER COMPANY

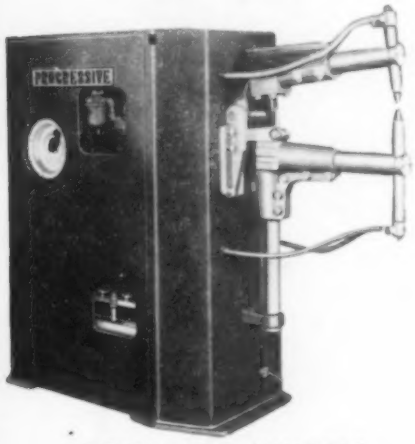
3050 E. OUTER DRIVE • DETROIT 12, U.S.A.



ROLLER HEAD PRESS WELDERS

For either projection or spot welding. Here, too, the roller head speeds follow-up — gives better welds. Rigid? Take a look at the frame in

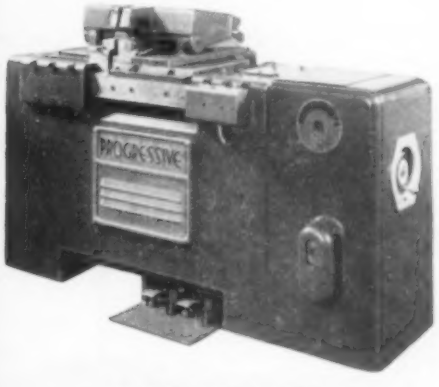
Bulletin #603



ROCKER ARM WELDERS

For all kinds of light to medium duty jobs. An up-to-the-minute "triple" threat: real "beef," real speed, and real adaptability.

Bulletin #702

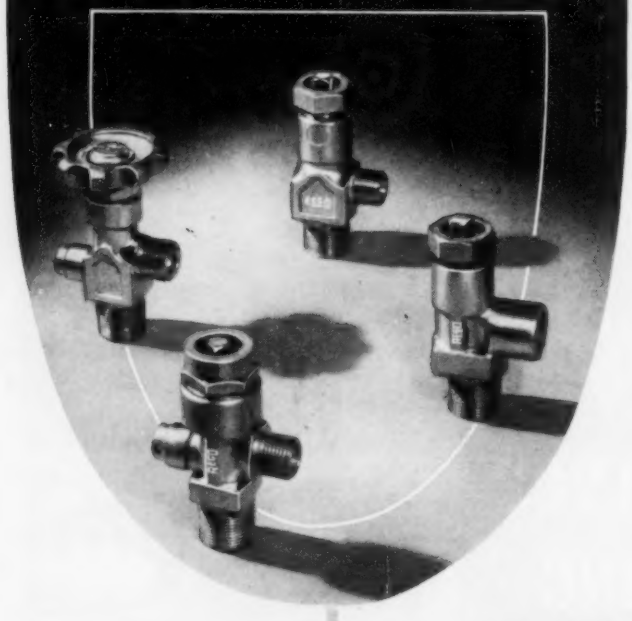


FLASH WELDERS

Combine the advantages of standard and special machines. More features than you would believe possible on a standard machine.

Bulletin #204

REGO*



HIGH PRESSURE
CYLINDER VALVES

for OXYGEN and HYDROGEN

Designed, tested and proved for high pressures and severe service.

Packing may be replaced with cylinder under pressure if necessary.

Fuse plug and bursting disc provide positive safeguard.

Bronze stem furnished as standard, also available with monel stem on special order.

for ACETYLENE

Listed by Underwriters' Laboratories.

Cadmium-plated steel stem with monel tip resists rust and wear.

Ball-nose seat construction assures positive shut-off.

for CARBON DIOXIDE

Available with diaphragm-type or packed-type construction.

Compact, rugged design for use with high pressures.

Equipped with bursting disc safety device.

*Reg. U.S. Pat. Office

REGO

The BASTIAN-BLESSING Company
4201 Peterson Ave. Chicago 30, Ill.

Pioneer and Leader in the Design and Manufacture of Precision Equipment for Using and Controlling High Pressure Gases

All awards were presented on Monday evening, October 25th during the annual meeting of the AMERICAN WELDING SOCIETY at the Bellevue-Stratford Hotel, Philadelphia, Pa.

Survey of Automatic Arc and Gas Welding Processes

The *Survey of Automatic Arc and Gas Welding Processes as Used in the Automotive Industry*, just issued by the AMERICAN WELDING SOCIETY, represents a compilation of information from users of the automatic welding processes, including Submerged Arc, Atomic Hydrogen, Shielded Metal-Arc, Bare Metal-Arc, Carbon-Arc, Inert-Gas Metal-Arc and Oxy-Acetylene Welding. While originally prepared from information on the use of these processes in the automotive industry, the data is of as much use to fabricators in any other industry.

The information is general covering each factor involved in each process such as fit-up, current, backing, edge preparation and speed of welding. It should be helpful in preparing the welding procedures to use for specific applications.

Copies of the 17-page *Survey of Automatic Arc and Gas Welding Processes as Used in the Automotive Industry* can be obtained from the AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, N. Y., at thirty cents each. The usual discounts apply to members of the SOCIETY.

Articles for section on Practical Welder and Designer, urgently needed.

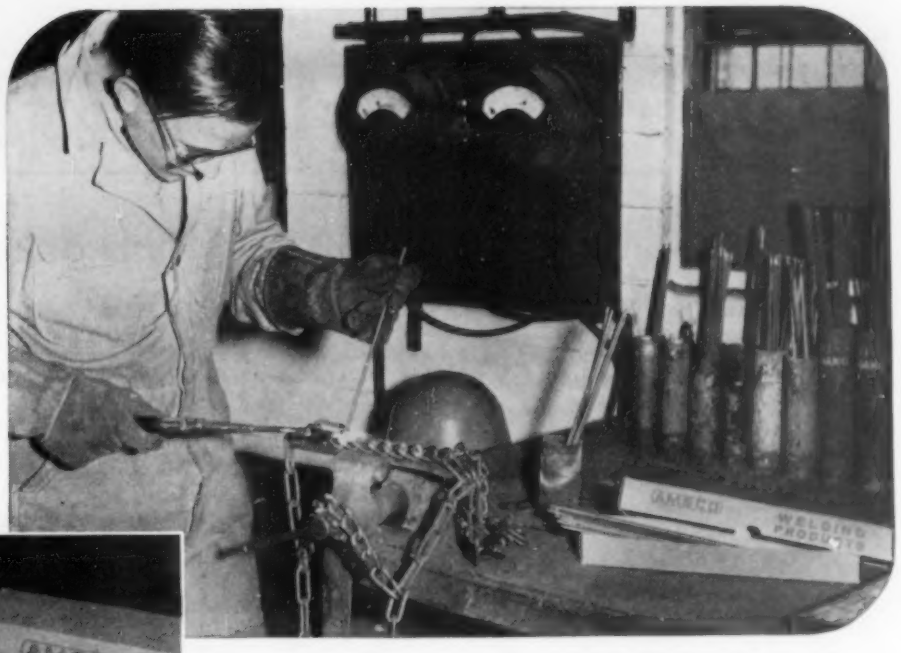
Employment Service Bulletin

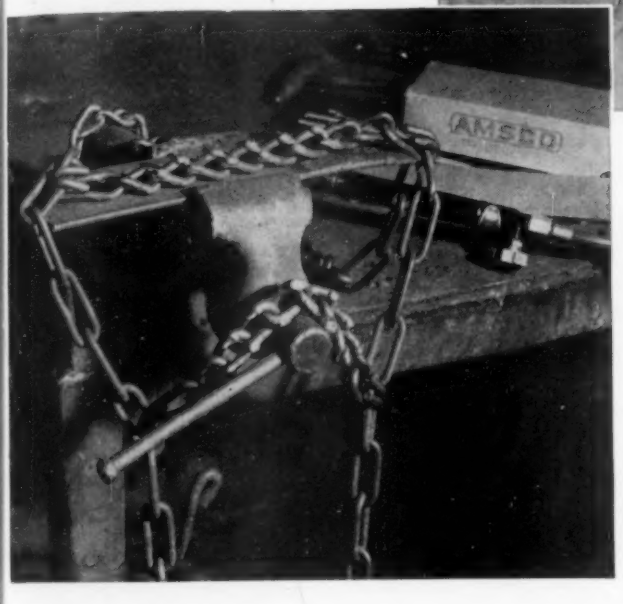
Positions Vacant

V-230. Competent young man with necessary metallurgical training and knowledge of physics to assist in summarizing and evaluating research information in various fields of welding. A knowledge of French and German would be helpful. Must have ability to write and to separate essentials and present them in usable form. Knowledge of welding helpful but not essential. Good salary depending upon age and experience.

V-231. Welding Engineer wanted for Chicago firm. Must have thorough training in practical welding and familiar with modern apparatus, materials and techniques for welding carbon steels, stainless steel and aluminum. Should be competent to conduct school for trainees and work closely with shop organization. Work comprises pressure vessels, tanks and heavy weldments.

HARDFACING TIRE CHAIN





FOR 5 TIMES LONGER SERVICE

WITH

AMSCO®

459 WELDING ROD

Here's unusual but convincing proof of how to save money through Amsco hardfacing. The tire chains shown here were practically worn out after two seasons' use. After hardfacing with Amsco #459 in 1938, *they have been in service ever since.*

Shown above is the welding operation—set of two chains hardfaced in forty minutes using 1½ pounds of rod. At left is a close-up—jagged edges were made purposely to insure better gripping on ice and snow.

This is but one example of the extra dollars you can put in your pocket through Amsco Conservation Welding. Amsco #459 is widely used by construction firms, mine and quarry operators, cement mills, clay products plants, highway departments, etc. for parts subject to severe abrasion and moderate impact.

Other welding products to cover any given combination of abrasion, impact and heat in the repair, build-up and hard surfacing of ferrous wearing parts are fully described in Bulletin 1047-W.

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo.
Made and sold in Canada by Canadian Ramapo Division, Joliette Steel Ltd., Niagara Falls, Ont.

NEWS OF THE INDUSTRY

Stress Analysis Meeting

The Annual Meeting of the Society for Experimental Stress Analysis will be held at Hotel Commodore, New York, N. Y. on December 2–4, 1948.

Inquiries should be addressed to the Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 39, Mass.

Clad Steel Talks

Dr. W. G. Theisinger, manager, Sales Development, Lukens Steel Co. and its divisions, By-Products Steel Co. and Lukenweld, Coatesville, Pa. is on an extensive business trip to the Pacific Coast. During this time he will be a featured speaker at six meetings of AMERICAN WELDING SOCIETY, American Society of Metals and American Society of Mechanical Engineers groups at Los Angeles, San Francisco, Portland, Ore., Seattle, Spokane and Richland, Wash. At each of these sessions, Dr. Theisinger will speak on "The Manufacture, Fabrication and Application of Clad Steels." His discourse will be illustrated by showings of the motion picture, "The Manufacture of Lukens Clad Steels," and with slides showing approved methods of welding and fabricating Clad Steels.

Clad Steels are a development of the Lukens Steel Co. in cooperation with The International Nickel Co. In 1930 these two concerns developed Nickel-Clad Steel in which a layer of nickel is bonded permanently and uniformly to a backing plate of ordinary steel. Thus, the corrosion-resistant and product-protecting qualities of nickel are obtainable at appreciable savings in cost over the metal in its solid form. Subsequently, Lukens developed Inconel-Clad and Monel-Clad Steels. Most recently it has perfected Stainless-Clad Steels, which are finding increased use in the pulp and paper, chemical processing and petroleum refining industries.

Award for Structural Design Textbook

The Trustees of The James F. Lincoln Arc-Welding Foundation, Cleveland, Ohio, have announced a joint award of $5000 to Prof. C. D. Williams of the University of Florida, Gainesville, Fla., and to Prof. E. C. Harris of Fenn College, Cleveland, Ohio, for their co-authorship of a textbook manuscript in the Foundation's Textbook Award Program. The Program's Jury of Award selected their manuscript entitled, "Structural Design in Metals," as the best modern textbook manuscript in the structural engineering field.

Prof. C. D. Williams is Head Professor of Civil Engineering at the University of Florida. He is author of *Analysis of Statically Indeterminate Structures*, a text used by many leading colleges. He is a member of the International Association of Bridge and Structural Engineers, Society of Experimental Stress Analysis, American Concrete Institute and other technical societies. He has been engaged in engineering practice and teaching for twenty-seven years.

Prof. Harris is Chairman of the Department of Structural Engineering at Fenn College, Cleveland, Ohio. He is a graduate of Fenn and has had a wide experience in structural engineering with the federal government and some of the leading structural engineering firms in the country. He joined the faculty of Fenn in 1942. He is a member of the American Society for Engineering Education, AMERICAN WELDING SOCIETY and the American Society for Testing Materials.

The James F. Lincoln Arc Welding Foundation was created in 1936 for the purpose of contributing to industrial progress by encouraging and stimulating the study of arc welding and its application. In furtherance of its aims the Foundation sponsored a $20,000 Textbook Award Program to encourage authors in the preparation of textbooks on structural and machine design for the use of engineering undergraduates. Through the program the Foundation is reducing the delay between process development in industry and the treatment of these new developments in textbooks.

In addition to the structural textbook by Professors Harris and Williams the final arrangements are also in process on a machine design textbook manuscript selected by the Jury of Awards.

The Jury of Awards in the structural section of the Textbook Award Program which rated the manuscript entered was composed of Dr. E. E. Dreese of Ohio State University, Chairman; Dr. H. E. Wessman of New York University, now Dean of Engineering, the University of Washington; Prof. F. W. Stubbs formerly of Rhode Island State College, now of the University of Illinois and Prof. G. E. Large of Ohio State University.

Engineering and Marine Exhibition, Olympia, London, Aug. 25–Sept. 10, 1949

In view of the success of the 15th and first postwar Engineering and Marine Exhibition, which was held at Olympia, London, England, in the Autumn of 1947, it has been decided that the whole of the vast Olympia premises shall be reserved for the 16th Exhibition to be held from Aug. 25 to Sept. 10, 1949. This represents an increase in exhibition space of some 33 1/3% and will enable 150 to 200 additional firms to exhibit.

The Engineering and Marine Exhibition has been held bi-anually since 1906, except for the interruptions caused by the two World Wars. In 1947 a record figure of 480 firms displayed their products.

The Engineering and Marine Exhibition continues to be the largest display of engineering manufactures in the world. In 1947 over 140,000 visitors attended the Exhibition and these included visitors from every continent. It is hoped that the steady improvement in delivery dates for engineering products will attract many friends from overseas in 1949.

Culbert Represents Arcos

Arcos Corp., Philadelphia, Pa., manufacturers of stainless steel and alloy welding electrodes, announces that Charles B. Culbert, Jr., is now permanently located in the Boston Area as company representative. Mr. Culbert, who has been with Arcos for a number of years, will maintain offices at 16 MacArthur Rd., Natick, Mass.

A Story of Shears and Scissors

The following is an abstract of the book *A Story of Shears and Scissors* being published by J. Wiss & Sons Co. on the occasion of its one hundredth anniversary.

When Jacob Wiss came to Newark in 1847, Newark had already attracted attention as an industrial center. Seth Boyden had invented a process for making ductile iron castings, and his foundry was soon turning out castings which would be welded or faced with steel.

Jacob Wiss entered the cutlery manufacturing in 1848. The beginning was not easy. Tools and machines had to be improvised. Drop hammers operated by hand were used for welding the cutlery steel blades to the malleable iron shear frames. He started his business in 1848, using a dog in a treadmill to power his grinding and polishing wheels.

The Wiss plant kept pace with inventive improvements, and in 1906, the first power drop hammers for hot forging steel shears frames were installed in the Littleton Avenue factory. These enabled Wiss to weld tough high-carbon steel blades to rugged frames of softer metal, making for the first time truly unbreakable shears and scissors which have no superior.

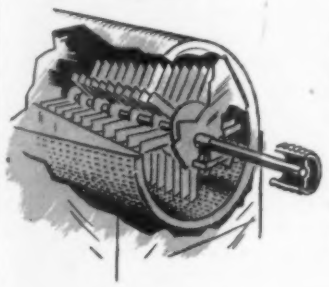
Experiments made by the artisans in the Wiss plant revealed that the welding of

how six Industries use HAYNES alloys

To Increase the Life of Wearing Parts

Major savings in maintenance, repair and replacement costs are being realized daily in practically every industry — through hard-facing. The sketches below show how six major industries have increased the life of parts subjected to heat, abrasion, and corrosion. These are typical examples of the savings made possible by HAYNES hard-facing alloys.

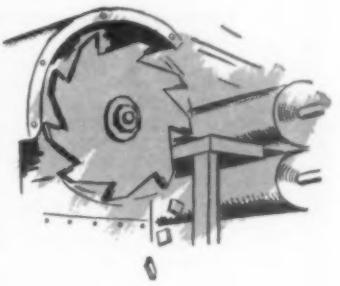
CHEMICALS



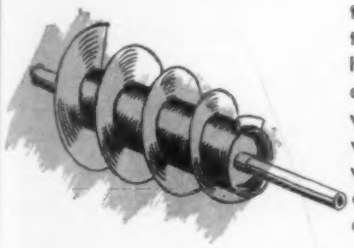
The hammers in this sulphur-pulverizing mill, hard-faced with HAYNES STELLITE alloy No. 1, are still in good condition after 30 days' service; whereas unprotected hammers lasted only 3 days. The hammers run at high speeds in a small jacketed mill.

PLASTICS

This rotary plastic cutter, using knives built-up with HAYNES STELLITE Alloy No. 12, cut 3-million lb. of 2-in. wide plastic sheet. The hardened tool steel knives, previously used, were worn out after cutting only 10-thousand lb. of the same plastic material.



PAINT

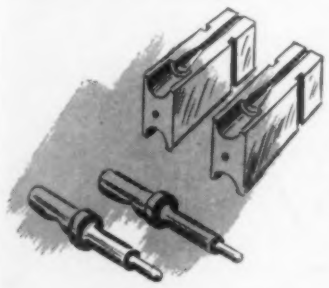


This screw conveyor, used to classify an abrasive titanium oxide pigment, is hard-faced with HAYSTELLITE composite rod. This conveyor shows practically no wear after 7 months' service. Unprotected conveyors had to be replaced after 15 days' service.

AUTOMOTIVE

Truck and bus valves and valve seat inserts that are hard-faced with HAYNES STELLITE Alloy No. 6 are giving over 100,000 miles of good service without a valve grind.

METAL-WORKING



Although these dies and punches, hard-faced with HASTELLOY alloy C, have been in continuous service for 32 days they are still in good condition. The heat-treated punches and dies that were used previously had to be scrapped after 8 to 10 days' service.

PUBLIC UTILITIES

Clinker crusher beams used in gas generators remain in service for two years when protected with HAYNES STELLITE Alloy No. 1. The beams that were previously used had to be replaced after 6-months' service.

HAYNES TRADE-MARK *alloys*

For more information on HAYNES hard-facing materials, write for the booklet, "Hard-Facing with Haynes Stellite Products."

Haynes Stellite Company
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

The trade-marks, "Haynes," "Haynes Stellite," "Hastelloy," and "Haystellite" distinguish products of Haynes Stellite Company.

Give your key men the up-to-the-minute facts on . . .

RESISTANCE WELDING

New fact program helps cut costs in your plant

Up-to-date knowledge of modern resistance welding is a *must* for your key men. Get this money saving information to them *now!*

IT'S EASY—General Electric has prepared all the facts in an easy-to-take, *visual* manner that's ideal for getting new ideas across *fast.*

Here's what the resistance welding program offers:

1. A fact-packed manual detailing the methods, practices, and equipment of *modern* resistance welding. It spells out objectively—*without sales bias*—the many ways in which this versatile industrial tool cuts costs and increases speed.

2. A full-color, sound motion picture, running about a half hour, showing how resistance welding solves problems similar to yours.

3. Fully-illustrated highlights booklets for individual study and review.

Convince yourself first—

We want you to judge for yourself whether the resistance welding program will pay off in your plant. That's why we offer business executives this chance to examine the *Resistance Welding Manual* without cost.

Showings cost you nothing. With your manual, we'll tell you how to arrange for a FREE film showing.

FREE
TO BUSINESS MANAGEMENT

Attach to your business letterhead

General Electric Co.
Section K684-3
Schenectady 5, N. Y.

Please send me a sample copy of the G-E *Resistance Welding Manual* without cost or obligation, with details on how I can arrange for a FREE SHOWING of the film. (Extra copies at regular manual price—$1.00.)

Name_____ Title_____

Company_____

Street_____

City_____

GENERAL ELECTRIC

two grades of metals produced the best shears. Jacob Wiss brought the making of shears and scissors to a fine art in America and enabled this country to surpass rapidly the techniques of shears-making in the cutlery centers of Europe.

There are four broad categories of shear, and scissors in America: hot drop-forged of forging steel with welded high-carbon crucible steel blades, hot drop-forged of a single piece of forging steel, cold-pressed from steel strips, and cast iron. The best shears are drop-forged with welded high-carbon crucible steel blades. They are tough, sharp and unbreakable. The cold-pressed scissors have no temper to enable them to retain sharpness while the cast iron types are brittle and snap under pressure.

The manufacture of fine quality scissors and shears is a manual rather than a mechanical art. Continuous training of apprentices is required in order to assure the maintenance of a high level of individual hand-craftsmanship and expertness in a number of operations calling for specialized skills. Fully 75% of the processes involved depends on manual craftsmanship.

Scissors range in size from 3 to 6 in. in length and are designed to do the lighter tasks of hand cutting.

Shears are manufactured in sizes ranging from 6 to 16 in. and are made to do the great variety of heavier cutting jobs in the home and in industry.

Snips are made to cut metal and will cut sheets up to 18-gage, about the thickest sheet metal that can be cut manually. Fabrication of Wiss scissors and shears may be divided into two general classifications: (1) Shears and snips which have high-carbon cutlery steel edges welded to forged steel frames. (2) Solid steel scissors, garden shears and snips which are forged from a single steel bar in one piece.

On the average, there are approximately 176 operations required in the manufacture of a pair of shears and about the same procedure is called for in making a pair of scissors, except that the welding process is omitted. The same precise handling and care are accorded the lighter products to the end that the brand name "Wiss" on either scissors or shears will continue to denote unqualified perfection and the avowed aim of the Company to insure the capability of each of its products to serve with maximum satisfaction the particular function for which it was made.

Forging requires the use of power hammers weighing from 300 to 2500 lb. In this operation, red hot bars of cutlery steel are drawn and forged in the dies after which the excess stock is sheared off and the forgings are further prepared for the welding and crucible steel cutting edges. After the welding operation, excess steel is again trimmed off and a long succession of grinding and fitting operations prepares the shears for heat treating.

In the heat-treating process each blade must be hardened and long-lasting cutting edges for which Wiss products are famous. Frequent inspection, following the application of precision instruments, is required to attain the necessary uniformity and all grinding is held within exacting specifications to prevent the drawing off of temper. Moreover, all Wiss welded shear and snip blades are individually matched so as to maintain the necessary standards of hardness similarity. No method of manufacturing employing interchangeable blades would provide the perfection achieved by the Wiss method of assembly in which matching numbers are used on the blades. These numbers can always be found on the inside of each blade at the screw hole.

Resistance Welding Sales

Orders for new resistance welding equipment received by member companies of the Resistance Welder Manufacturers Assn. during August showed a 22% gain over July totals, according to T. S. Long, President of the Association. While shipments during August dropped slightly, due to vacation periods in several of the plants manufacturing resistance welding equipment, they nevertheless managed to keep pace with new orders, thus avoiding an increase in the 4 months' backlog of orders on hand.

Shipments of resistance welding electrodes also showed a gain in August over July, reflecting increased utilization of resistance welding equipment by metal working industries. Electrode shipments reported currently are running 15% higher than a year ago, the Association reports.

NCG Moves Into New General Offices

New executive headquarters from which will be directed the nation-wide activities of the National Cylinder Gas Co., manufacturer of industrial gases, oxyacetylene welding apparatus, arc welding equipment and electrodes, have been established in the seven-story building at 840 N. Michigan Ave., Chicago, recently purchased by the firm.

The building houses, in addition to executive offices, all administrative departments, including legal, personnel, credit, engineering, advertising, accounting and purchasing. The new quarters will be the nerve center for a sales system which includes offices in 55 major cities.

Extensive alterations now in progress will provide a year-round air conditioning system, modern lighting, and acoustical ceilings.

The Chicago district sales office will remain at its present address, 4700 W. 19th Street.

New NCG Offices

A change in the carton but no change in the high quality of the contents! Both our fibre and metal containers are now identified by bright colors recognizable at a glance. For champion performance choose Champion Welding Electrodes . . . they are everything the name implies.

Pierre Champion
PRESIDENT

CHAMPION ELECTRODES are Weld Rated Electrodes

THE CHAMPION RIVET COMPANY

CLEVELAND, OHIO — EAST CHICAGO, IND.

Air Reduction Appoints New Dealer in Hartford, Conn.

Adelson-Wirts, Inc., has been appointed an authorized dealer in Airco products according to an announcement by the Air Reduction Sales Co.

The new firm is located at 1800 Park St. in Hartford, Conn. They will carry a complete line of welding and cutting gases, apparatus and supplies, arc welders and carbide.

S. S. Adelson, one of the principals, has many years of experience in the welding and cutting field including a 13-yr. tenure with Air Reduction. Mr. Adelson joined Airco in 1935 as a technical specialist. In 1941 he became a salesman in the Metropolitan district with his headquarters in the Hartford area, a position he held until the formation of Adelson-Wirts, Inc.

New Limits in Non-ferrous Pipes and Tubes

As a result of continued research and experiments with wartime equipment, it is now possible to produce seamless tubes and pipes in sizes more than double those available before the war, it was announced by James F. McNamara, vice-president of The International Nickel Co., Inc.

Mr. McNamara said that a 4000-ton extrusion press, installed at Inco's Huntington Works during the war and used largely for the production of rotating shell bands, is now producing pipe in nickel, Monel and other high-nickel alloys in diameters up to 9¼ in. and in lengths up to 12 ft.

"These shapes can be further cold drawn into seamless pipe 8 in. in diameter, wall thicknesses up to ¾ of an inch and in varying lengths," he said.

"Prior to the war, the largest size available in pipe and tubing of nickel and the high-nickel alloys was 5 in. in diameter. Since the end of the war, we have been endeavoring to increase the size ranges up to the present limits.

"While large piping and tubing in the Inco nickel alloys have been available in centrifugally cast or welded form, this is the first time they have been made in these sizes by forging, extruding and cold drawing into seamless form.

"Welded tubing and piping in large sizes in these alloys have proved highly satisfactory for a vast number of applications, but there are a number of uses for which many industries prefer the seamless form.

Compressor Tanks

The accompanying photo shows final inspection of electric arc-welded air compressor tanks at the plant of Whitehead & Kales, River Rouge, Mich.

Thousands of these tanks, built strictly to A.S.M.E. Code, are being produced by Whitehead & Kales.

SERVICE • BUILT FOR BETTER SERVICE • BUILT FOR BETTER

Lightweight, Sturdy Protection . . .

● DOCKSON cover-spectacle goggles are hard to beat. Designed for maximum comfort and ample ventilation, they are light weight, non-fogging and sturdy.

Replaceable lenses to your specifications, permit wide vision range. Rigid brace bar allows easy adjustment and convenient raising and lowering with one hand.

These goggles offer maximum protection and comfort. Available for chipping, grinding or welding use.

(Write for our Welding & Safety Equipment Catalogs)

DOCKSON CORP. 3839 WABASH • DETROIT 8, MICH

Dockson

BUILT FOR BETTER SERVICE • BUILT FOR BETTER SERVICE • BUILT FOR BETTER SERVICE • BUILT FOR BETTER SERVICE •

SPOT WELDERS

OF ALL TYPES
SIZES 1/4 TO 300 KVA.
FOR MANUAL, AIR, MOTOR, OR ELECTRONIC OPERATION.
also BUTT, ARC, and GUN WELDERS

TRANSFORMERS
For Furnaces, Lighting, Distribution, Power, Auto Phase Changing Welding, and Special Jobs.
AIR OIL, and WATER COOLED.
Sizes 1/4 to 300 KVA.

CHARLES EISLER
EISLER ENGINEERING CO., INC.
779 South 13th St. (Near Avon Ave.) NEWARK 3, N. J., U.S.A.

WELDING CONNECTORS
Saxe System Welded Connection Units
for welded assembly

Saxe Units place in position and securely hold together structural parts to be welded.

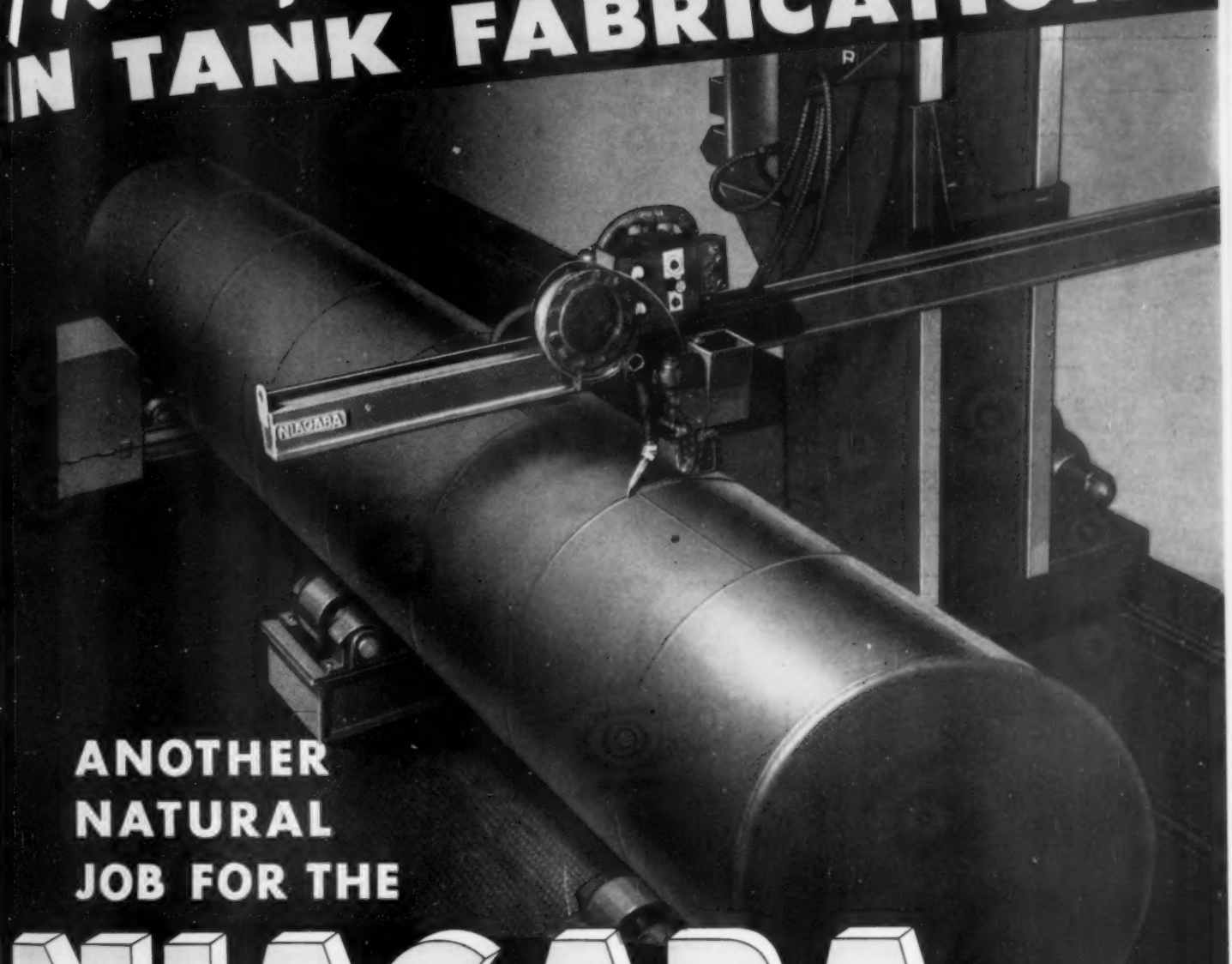
As used in many welded structures they *eliminate all hole punching*, producing an economical, rigid, safe and quickly erected structural frame.

Write for descriptive literature

J. H. Williams & Company
Buffalo 7, New York

G. D. Peters Company
Montreal 2, Canada
Canadian Representatives

The New Look IN TANK FABRICATION



ANOTHER NATURAL JOB FOR THE

NIAGARA

Electronic Automatic WELDING MACHINE

GITUDINAL WELDS AND CUMFERENCIAL WELDS

ger tip control with infinitely ble speed in either direction t weld size and tank diameter.

TAKE ADVANTAGE OF

FASTER SET UP... Power Elevated Welding Beam is quickly positioned over job.
FASTER WELDING... Increased welding current, increased speed.
STRONGER WELDS... Deeper penetration of weld.
MORE VERSATILITY... Tanks of any diameter, any length.

AGARA MACHINE & TOOL WORKS • BUFFALO 11, N. Y.
STRICT OFFICES: DETROIT • CLEVELAND • NEW YORK

NEW LITERATURE

First Aid in War on Corrosion

To help industrial designers, engineers and buyers cut the cost of important machine components and accessories, about 200 standard products for corrosive and high temperature service are listed in a new catalog by The International Nickel Co., Inc. Checked by manufacturers of each item, this new *Standard Specialties* catalog is the first complete compilation of products made of Monel, nickel or Inconel and available economically from stock or from standard designs.

Among the hundreds of *Standard Specialties* described and illustrated under 47 general classifications are balls, floats, nails, bolts, pickling slings and hooks, thermostat parts, thermocouple protection tubes, pipe and pipe fittings, gaskets, valves, cathodes, grease fittings, tags, woodruff keys, wire rope and vibration isolators.

Copies of this *Standard Specialties* catalog are offered to industrial purchasing agents, engineers, product designers and other executives concerned with purchase and product specification, through The International Nickel Co., Inc., 67 Wall St., New York, N. Y.

Rail Transportation Record

The American Railway Car Institute's year book of statistics on the building, repair and use of railway cars was compiled first in 1923 in much briefer form and as a service to Institute members. The book has been very largely expanded through recent years until it has become generally recognized as a "bible"—packed with useful source material—of the railway transportation industry.

This year's Silver Anniversary edition carried forward the statistical story of postwar progress toward the needed replacement of a large part of the freight car fleet and in extending the "streamlining" of passenger service. In this record also are freight service statistics showing how the railroads have been able to repeat under peacetime conditions the operating miracles of the war years.

Salient parts of the statistical story of 1947 have been carried forward into 1948.

Eutectic Eight-Page Bulletin

A new, eight-page bulletin announces the latest improvements in low-heat welding alloys manufactured by Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.

The July-August issue of the *Eutectic Welder*, stresses the technically improved Eutectic welding alloys available for all torch and arc users: Eutectrode 24, for cast-iron welding without preheat, Eutecrod 185FC with new, improved flux-coating and Eutecrod 1805FC, the latest addition to the Eutectic line of welding alloys for joining copper.

Also announced is the new Cuttrode, in size $^3/_{32}$ in. for cutting thin sheet metal using no special equipment. Simple and enlightening graphs visually explain the advantages of these products for lowheat welding. This Scientific Development Issue is available by writing to Eutectic Welding Alloys Corp.

New Burdox Catalog

A new 68-page catalog on welding and cutting equipment and supplies and safety equipment has just been released by Burdett Oxygen Co., Cleveland, Ohio. This new catalog illustrates and describes completely the most modern equipment used in the welding field today. The new catalog offers not only the actual equipment needed for every type of welding and cutting job, but such protective equipment as goggles, helmets, portable lights, gloves, etc.

Copy of this catalog is available upon request to Burdett Oxygen Co., 3303-Q Lakeside Ave., Cleveland 14, Ohio.

Booklet on Hardfacing Line

A hard-facing booklet, covering the complete new line of Airco hard-facing alloys, has been published by the Air Reduction Sales Co.

The 16-page, two-color, profusely illustrated booklet, which also serves as a hardfacing catalog, describes each of Airco's new alloys in complete detail. Included are data on typical uses, specifications, application technique, deposit hardness, color markings and deposit analysis. Every page is full of helpful, authentic information on how to combat wear and increase equipment work-life.

Copies of this valuable descriptive booklet may be obtained free by writing Dept. 1968, Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., or the Airco Sales Office nearest you.

Metallizing Equipment

The Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y., announces a new catalog of its complete line of metallizing equipment and supplies.

The Best of Everything for Metallizing is a complete catalog of metallizing equipment, accessories and supplies. In it you will find metallizing guns for every purpose, air and gas controls, spray booths and dust collectors, blast machines and nozzles and air compressors to give you clean, dry air. Each piece of equipment is clearly illustrated and described. There is also a description of each of the special Metco metallizing wires.

Three new accessories are introduced. (1) A Wire Control and Straightener Unit to increase spraying speeds and reduce wear on your gun. (2) A Gas Flow Meter Unit, the first of its kind, to assure maximum efficiency, higher spraying speeds and greater gas savings. (3) An Air Control Unit that assures you of properly controlled air pressures.

You will find these new accessories and the complete line of Metco equipment, accessories, wires and supplies in Catalog 401. Write for your copy today.

German Textbook

Schweissen der Eisenwerkstoffe (*Welding of Ferrous Materials*), by K. L. Zeyen and W. Lohmann, 2nd ed., 1948, 456 pages, published by Verlag Stahleisen M. B. H., Dusseldorf, Germany.

This is a comprehensive book on welding steels, alloy steels and cast iron by all processes. It is based largely on literature references of which there are 1057. This second edition is patterned closely after the first edition which was printed in 1943. Several sections are new or enlarged, namely the sections on electrode coatings, hard alloys, welding of tool steels and wear and corrosion of welds.

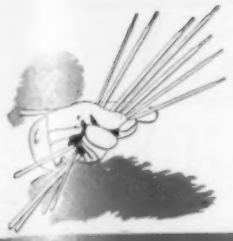
Lenape Bulletin

Lenape Hydraulic Pressing and Forging Co., announces the publication of Bulletin 4-82. This bulletin is a thorough presentation of Lenape Type R and SR Manway necks, nozzles and covers. The flexibility and versatility of design, made possible by using the Type R and SR Manways, is emphasized by the inclusion of full data on size, range, style, materials, construction and application. For your copy of Bulletin 4-82 write Lenape Hydraulic Pressing and Forging Co., Dept. 7, West Chester, Pa.

Stud Manual

A new 28-page operating manual covering the application of Nelson automatic electric-arc studwelding has just been published by the Nelson Stud Welding Division of Morton Gregory Corp., Toledo Ave. and E. 28th Street, Lorain, Ohio.

Of interest to design engineers and production departments, the illustrated manual details the studwelding procedure and describes typical applications; lists various stud types, with tables of physical properties; tabulates dimensional and tolerance data; describes design and use of stud locating templates and gives complete information on maintenance of the Nelson studwelding gun and timer control unit.



Sound Stainless Welds —Any Position, Any Current!

SMITHway Certified

AC-DC STAINLESS ELECTRODES

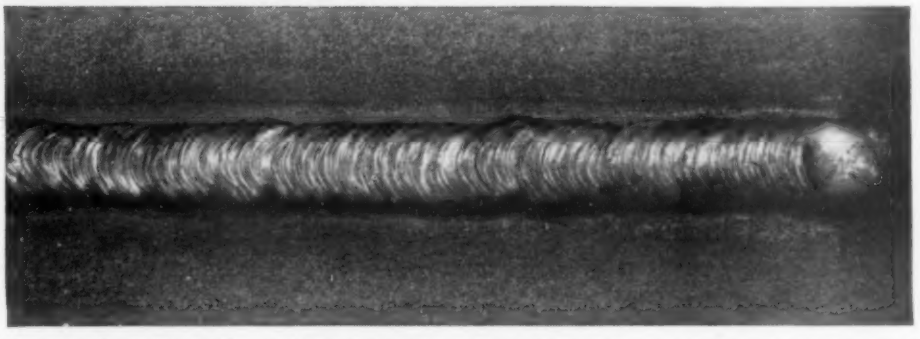
SW-357 • SW-359 SW-362

SMITHway Stainless AC-DC Electrodes are shielded-arc, all-position electrodes for better welding of stainless steel and stainless alloys. They are certified, like all SMITHway Electrodes, for uniform quality and characteristics.

SMITHway AC-DC Electrodes give users the maximum flexibility of application. They minimize the necessity for maintaining large assorted stocks of special electrodes to meet specific uses and current requirements. They cut welding costs.

MADE BY WELDERS . . . FOR WELDERS

Sold by Distributors Everywhere



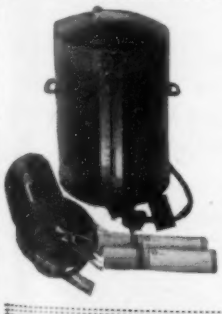
Unretouched photo of bead. SMITHway Stainless Electrodes produce sound, X-ray-quality welds in all positions—no undercut at edge of weld and no porosity after grinding.

PROVED IN PRODUCTION

A. O. Smith originated modern heavy-coated electrodes and modern welding techniques. Proof of SMITHway Electrodes has been given repeatedly in their huge production record. More than 320,000 have been used *daily* in A. O. Smith plants . . . millions more, by other manufacturers.

A. O. SMITH Corporation

New York 17 • Philadelphia 5 • Pittsburgh 19 • Cleveland 4 • Atlanta 3 • Chicago 4 • Tulsa 3
Midland 5 • Dallas 1 • Houston 2 • Seattle 1 • San Francisco 4 • Los Angeles 14
International Division: Milwaukee 1



SMITHway AC Welders

Under the most severe operating conditions, SMITHway Welders stand up under treatment that punishes other machines. Practically no maintenance is ever required. Power cost is cut to a minimum. Heavy-Duty, General-Purpose and Utility Models. Send the coupon for full specifications.

SEND FOR Free Electrode Catalog

A. O. Smith Corp., Dept. WJ-1148, Milwaukee 1, Wis.
Without obligation, send us

- ☐ Free SMITHway Electrode Catalog
- ☐ Bulletins on SMITHway AC Welders

Name_____

Firm_____

Street_____

City_____ State_____

NOW... SAVE MONEY

on Welding Rods and Electrodes

by using

BURDOX

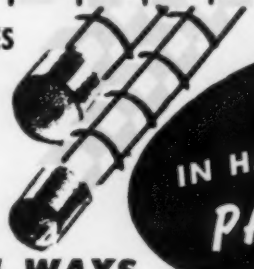
Thriftipaks

ARC WELDING ELECTRODES

Steel, cast iron, bronze.
In sturdy 18" tubes.

GAS WELDING RODS

Steel, bronze.
In sturdy 36" tubes.



NOW IN HANDY, LABELED PACKAGES

YOU SAVE IN 4 WAYS

Save lost time hunting for rod—just reach for the package!
Save losses on bent or damaged rod—Thriftipaks keeps it right!
Save losses due to mix-ups on rods—Thriftipaks are marked!
Save welding time—Thriftipaks give you the best rod for the job!

No matter how few rods you use, chances are that they cost you more than you paid for them, if you bought them in bulk! Loose, unused rods end up as a total loss because they become bent, damaged or unidentified. Why waste rod...why waste time? Get Burdox Thriftipaks...and save the difference in time, temper and money on every welding job. Ask for them at your distributor's, or write direct for types and sizes. Burdox welding rods and electrodes are also available in 50 and 100 lb. bundles for large users.

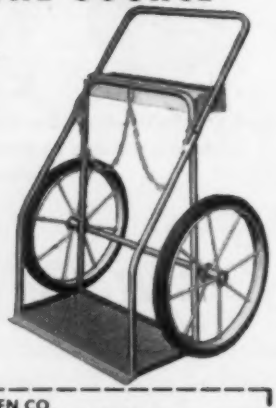
THE BURDETT OXYGEN CO.
3304 LAKESIDE AVENUE CLEVELAND 14, OHIO

Make EXTRA SAVINGS by buying all your welding needs at ONE SOURCE

Extra-Flex Welding Cable

Safety Equipment

Portable Cylinder Trucks



Take advantage of big savings in time and money by standardizing on BURDOX products for all your welding and cutting needs. Designed by welding men, every BURDOX Product offers you the latest improvement and superior quality at prices that mean savings to you. At all leading distributors of welding supplies.

The BURDOX line includes

Welding & Cutting Outfits • Regulators and Torches • Cutting Machines • Pressure Gauges • Acetylene Generators • Hose and Hose Connections • Cylinder Trucks • Lenses • Goggles • Face-Shields • Cable • Soldering and Brazing Outfits • Helmets.

THE BURDETT OXYGEN CO.
3333 Lakeside Avenue, Cleveland 14, Ohio
Please send full details on Burdox Thriftipaks:

Name_____
Firm_____
Address_____
City & State_____

"WELD SECURELY"

Do YOU Specify your welding requirements this way?

Do you know what the welding requirements are for bridges, buildings, piping, storage tanks, pressure vessels or whatever your type of fabrication?

This information, necessary for solving your practical, every-day welding problems, will be found in the standards issued by the American Welding Society.

Are You

—a Designer?

—a Welding Engineer?

—a Welding Operator?

—or engaged in any other capacity as a Purchasing Agent, Salesman or Administrative Executive?

Then you should know what the material, filler metal, design, workmanship, inspection and qualification requirements are for different products and structures. You should be familiar with the standard welding nomenclature and welding symbols used in everyday welding conversation and correspondence, in technical articles and in contract specifications and regulatory requirements.

If you are not already familiar with the codes, standards and specifications of the American Welding Society as well as the educational books, ask the Technical Representative (Liaison Officer) of your Local Section for a free copy of Bulletin 101 describing these publications. Also ask about the special discounts to members. If you prefer, write directly to AWS Headquarters.

It is easy to keep informed through American Welding Society technical publications.

They will help you.
Use them!

On the Job with Hard Surfacing

TUNGSTEN-CARBIDE. Reaming surfaces of this drilling bit are hard surfaced with new Lincoln "Tungweld F." Its fine tungsten-carbide particles produce smooth, keen edges to resist extreme abrasion. "Tungweld C" with coarse particles is for use where a jagged, fast-cutting edge can be used.

DOUBLES LIFE. Hard-faced with "Abrasoweld" the edge of this concrete tile mold segment gives double the original life. Deposits of this electrode are not only highly resistant to abrasion but also withstand pronounced battering and impact.

LINCOLN HARD SURFACING ELECTRODES

For Hard Surfacing to Resist Extremely Severe Abrasion
"TUNGWELD"

For Building Up High Manganese Steel to Resist Moderate Abrasion and Extremely Severe Impact
"MANGANWELD"

For Building Up Worn Steel Parts to Resist Moderate Impact and Light Abrasion
"HARDWELD"

For Building Up New and Worn Steel Parts to Resist Rolling or Sliding Abrasion
"WEARWELD"

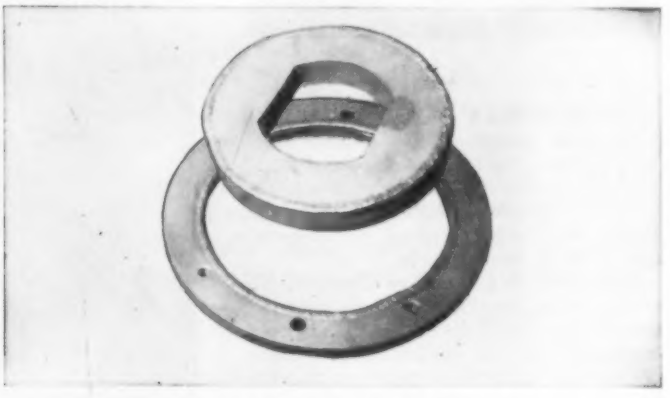
For Building Up New and Worn Parts to Resist Severe Impact and Moderately Severe Abrasion
"ABRASOWELD"

For Hard Surfacing with Thin Layer to Resist Severe Abrasion
"SURFACEWELD"

For Hard Surfacing New and Worn Parts to Resist Severe Abrasion and Moderate Impact
"FACEWELD"

For Making Metal Cutting Edges
"TOOLWELD"

A CASE OF SEVERE ABRASION. The drag chain of this cement mill conveyor, hard-faced with several layers of "Faceweld 12," has a hardness of about 60 Rockwell C. Hard-faced parts greatly outlast original ones.



CUTS COST OF TOOL PARTS. This 12″ blanking die is made of inexpensive carbon steel. The mating edges are tool steel, applied with "Toolweld A&O." Both edges will be ground to size. Their life is as long as it would be if expensive tool steel had been used throughout.

The above is published by LINCOLN ELECTRIC in the interests of progress. Handy pocket-size "Welding Guide" free on request. Write The Lincoln Electric Company, Dept. 1011, Cleveland 1, Ohio.

Advertisement

PERSONNEL

R.P.I. Metallurgists Receive Welding Society Awards

The AMERICAN WELDING SOCIETY announces the selection of three metallurgical engineers of the Rensselaer Polytechnic Institute as the winners of the first and second prizes in the 1948 Resistance Welder Manufacturers' Assn. Prof. W. F. Hess, Head of the Department of Metallurgical Engineering, and Drs. W. D. Doty and W. J. Childs, Research Fellows, collaborated as authors of the best and second best papers submitted in the contest. The awards were presented on October 25th at the annual meeting of the SOCIETY at the Bellevue-Stratford Hotel, Philadelphia, Pa.

W. F. Hess

The three men won the $300 first prize with their paper entitled "The Heat Treatment of Spot Welds in Steel Plate." Prof. Hess and Dr. Childs were also co-authors of the paper entitled "A Study of Projection Welding" which was selected for the $200 second prize.

Prof. Hess is a native of Troy, N. Y., and received his Doctor of Engineering degree from R.P.I. in 1928. He has been associated with that institution as a member of the faculty since that time, having been made a full professor in 1945 and head of his department in 1947. He was President of the AMERICAN WELDING SOCIETY for the year 1945–46 and is the recipient of many honors. Among these are the Lincoln Gold Medal of the AMERICAN WELDING SOCIETY in 1944, the American Iron and Steel Institute Medal in 1945, and the John Price Wetherill Medal from the Franklin Institute in 1948.

L. D. Doty

Dr. Doty has recently joined the Carnegie-Illinois Steel Corp., Pittsburgh, Pa., as a welding metallurgist in its Research and Development Div. He is a graduate of R.P.I. with the class of 1942 and received a Ph. D. in Metallurgy in 1946. He is a member of several technical societies and the author of a number of research papers on welding.

W. J. Childs

Dr. Childs is now a member of the research staff, Div. of Industrial Cooperation, Massachusetts Institute of Technology. He joined that staff after receiving his Ph. D. in Metallurgy from R.P.I. in June of this year.

Taylor-Winfield Men Win Welding Awards

The AMERICAN WELDING SOCIETY announces the selection of three engineers of the Taylor-Winfield Corp., Warren, Ohio, as the winners of the second and third prizes, totalling $750 in the 1948 Resistance Welder Manufacturers' Contest. R. C. Jones, Sales Engineer, won the second prize of $500; C. E. Smith, Chief Electrical Engineer, and R. H. Blair, Research Engineer, took the third prize of $250. The awards were presented on October 25th at the annual meeting of the SOCIETY at the Bellevue-Stratford Hotel, Philadelphia, Pa.

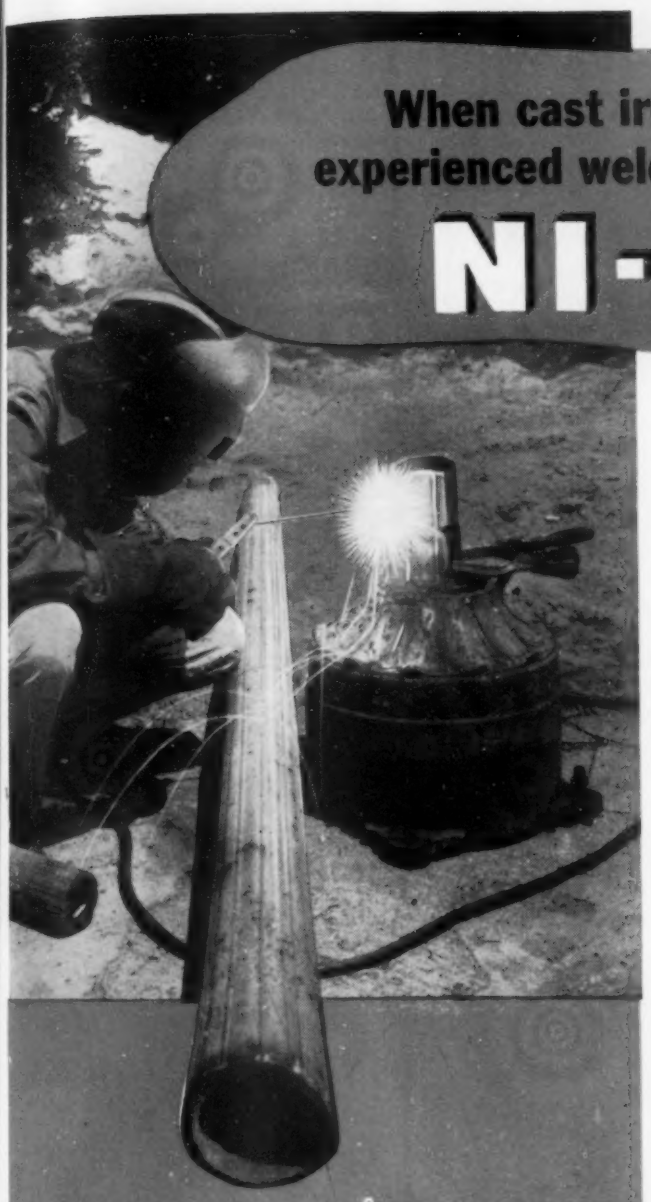
R. C. Jones

Mr. Jones won second prize as author of the paper entitled "Resistance Welding Crossed Wires." Mr. Smith and Mr. Blair were co-authors of the third-prize paper on the subject of "Resistance Welding Characteristics of the Dry Disk Rectifier Welder."

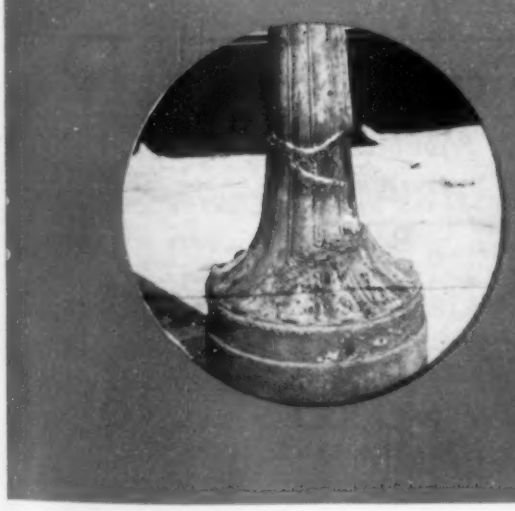
Mr. Jones is a native of Warren, Ohio, and has held several positions with the

C. E. Smith

When cast iron calls for help... experienced welders call for NI-ROD



Repairing a 250-pound cast iron lamp post with 1/8" NI-ROD Electrode. The General Welding Service, Elmhurst, L. I., N. Y. find that NI-ROD gives the best results of any electrode they have tried in this service. NI-ROD gives such smooth bead contour that it is not necessary to grind welds flush. A new coat of paint completes the repair.



When emergencies arise and they can't bring the job to you . . . you can take NI-ROD* to the job.

NI-ROD can't be beat for on-the-spot cast iron repairs because it needs no coddling . . . seldom requires preheating or postheating . . . gives stable arc on AC or DC . . . and makes sound, *machinable* welds.

Typical example of NI-ROD's on-the-spot usefulness was the *Case of the Irreplaceable Lamp Post.*

A motorist, whose daring exceeded his skill, demolished a lamp post in Forest Hills Gardens, Long Island, N. Y. This was no ordinary lamp post. It was a work of art in cast and wrought iron, virtually irreplaceable, so repaired it *had* to be.

Mr. Patrick O'Brien, superintendent of the Forest Hills Gardens development, sent a call for help to Messrs. Thompson and Shannon of General Welding Service, Elmhurst, L. I. They arrived on the scene equipped with mobile welding generator and NI-ROD. Result? In short order, the precious lamp post was back on its feet, practically as good as new.

Lamp post mayhem is a fairly common occurrence in his bailiwick, reports Mr. O'Brien. But thanks to NI-ROD and the skill of General Welding Service technicians, the aristocratic lighting fixtures are being preserved.

In addition to its usefulness in all-around cast iron maintenance work, NI-ROD gives excellent results in repairing close-tolerance castings. NI-ROD minimizes the danger of warpage, and original dimensions can be preserved.

NI-ROD comes in 3/32", 1/8", 5/32" and 3/16" diameters. Order a five-pound package from your distributor—and see for yourself how NI-ROD takes the "fight" out of welding cast iron. *Reg. U.S. Pat. Off.

Free — *new welding booklet: "NI-ROD . . . a new electrode for all cast iron welding."*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N. Y.

EMBLEM OF SERVICE INCO NI-ROD

R. H. Blair

Taylor-Winfield Corp., including that of Test Engineer, Laboratory Engineer and Design Engineer before taking his present position of Sales Engineer. He was formerly a technician in the Research Dept. of the Republic Steel Corp. at their Warren and Niles, Ohio, plants.

Mr. Smith directs the Customers' Sample Laboratory, the Research Laboratory and all electrical engineering investigations at the Taylor-Winfield Corp. Before joining this company he was a Design and Development Engineer in the Electronic Section of the Westinghouse Electric Corp.

Mr. Blair, a graduate of the University of Michigan in 1938, has been with his present employer since 1942 where he has devoted his time to welding problems in the research laboratory. He was formerly with the Westinghouse Electric Corp. working on distribution and power transformers.

These awards are made annually for the second and third best papers from an industrial source on original work in the field of resistance welding. The contest, sponsored by the Resistance Welder Manufacturers Assn., provides $2000 in prizes for papers submitted to the AMERICAN WELDING SOCIETY.

E. Paul DeGarmo Wins Lincoln Gold Medal

As the author of the paper representing the greatest contribution to the advancement and use of welding, E. Paul DeGarmo, Associate Professor of Mechanical Engineering, University of California, Berkeley, Calif., received the 1948 Lincoln Gold Medal from the AMERICAN WELDING SOCIETY. The award, sponsored by James F. Lincoln, President, Lincoln Electric Co., was presented on October 25th at the annual meeting of the SOCIETY at the Bellevue-Stratford Hotel, Philadelphia, Pa.

Prof. DeGarmo was in charge of investigations at the University of California from 1943 to 1947 for the Office of Scientific Research and Development on the problems of failures in welded merchant vessels. His paper entitled "Tests of Various Designs of Welded Hatch Corners for Ships," published in the February 1948, issue of THE WELDING JOURNAL, was selected by the SOCIETY as the outstanding paper on welding for the year.

Prof. DeGarmo is a graduate of the University of Washington and the California Institute of Technology, receiving his masters degree from the latter in 1937. Before joining the faculty of the University of California in 1937, he was an industrial engineer for the Converse Co., Inc., Seattle, Wash., and the Firestone Tire and Rubber Co., Los Angeles, Calif.

He is the author of two well-known textbooks: *Introduction to Engineering Economy* and *Technical Lettering*. Prof. DeGarmo is also either the author or co-author of 26 papers dealing with welding, engineering economy and motion study. He is a member of the A.W.S., A.S.M.E., A.S.M. and has been honored by Phi Beta Kappa and Sigma Xi.

E. Paul DeGarmo

Frank G. Harkins Wins $750 Prize for Resistance Welding Paper

The AMERICAN WELDING SOCIETY awarded the first prize of $750 in the 1948 Resistance Welder Manufacturers' Assn. contest to Frank G. Harkins, Welding Engineer, Solar Aircraft Co., San Diego, Calif. The award was presented on Monday, October 25th, during the annual meeting of the Society at the Bellevue-Stratford Hotel, Philadelphia, Pa.

Mr. Harkins won the prize with his paper entitled "Spot Welding Schedules for Nickel and Nickel Alloys." Mr. Harkins is a native of Pittsburgh, Pa., and

Frank G. Harkins

Time Counts—
Gas cut and Weld with
Shawinigan Carbide
SHAWINIGAN
SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

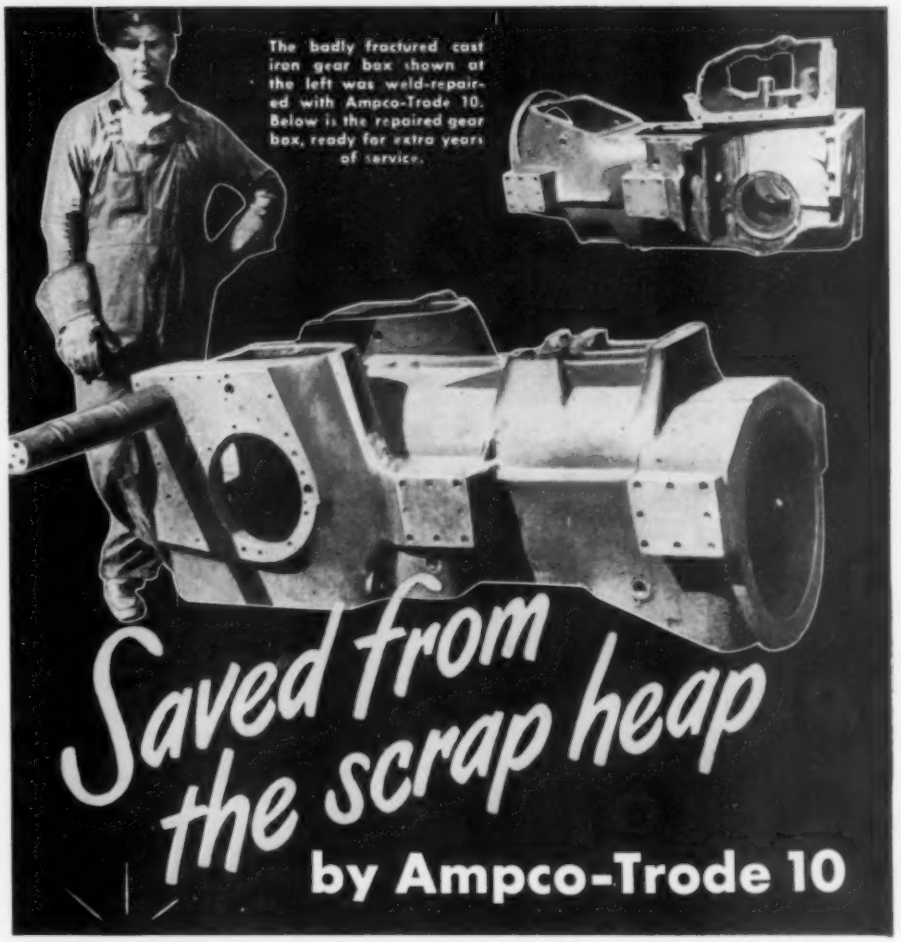
TIP CLEANING DRILLS
Mounted in Knurled
BRASS Handles
•
LARGE STOCK
PROMPT DELIVERY
•
DISTRIBUTORS WANTED
NEW MEXICO STEEL CO.
Box 1546, Santa Fe, N. M.

POPULARIZING THE WELDING JOURNAL

The Publication Committee has instructed the Editor to add a special section in The Welding Journal each month, under some departmental heading as "Practical Welder and Designer." The nucleus of this special section will be one article each month of not more than four pages nor less than two which will give practical information on how to do a specific job, covering as many of the following topics as possible:

1. An exact procedure with illustrations of how to do the job.
2. Detail information as to design.
3. Full information on welding procedure or fabrication details.
4. Testing and inspection.

The Publication Committee has set aside $50 each month for payment of accepted articles of this nature. They should be written preferably by one who has followed the specific application in detail. Clear photographs or charts will be helpful and should be utilized.


The badly fractured cast iron gear box shown at the left was weld-repaired with Ampco-Trode 10. Below is the repaired gear box, ready for extra years of service.
Saved from the scrap heap
by Ampco-Trode 10

Emergency repairs with Ampco-Trode 10 keep your equipment on the job longer, save replacement expense

When a few cents worth of Ampco-Trode Electrodes saves a part worth hundreds of dollars, that's real economy. And that is what happens every day in plants throughout the country. *You can make the same savings in your plant.*

Just keep a supply of Ampco-Trode 10 on hand. When breakdowns occur, your own maintenance men can have the part back on the job in a hurry. You avoid expensive down-time delays. And you avoid the cost of replacements.

The badly fractured cast iron gear box shown above was repaired with Ampco-Trode 10. That is a typical example of the way Ampco-Trode saves costly parts from the scrap heap. Ampco-Trode 10 is ideal for cast iron. Deposits are dense and ductile; they have a high strength-yield ratio. Ampco-Trode 10 gives a well-brazed bond with a low base-metal dilution. This prevents weld and fusion-zone cracking in highly stressed assemblies.

A supply of Ampco-Trode 10 on hand at all time will reduce "special electrode" inventories because it welds cast and malleable irons, steels, bronzes, brasses and dissimilar metals. Call your Ampco welding distributor today. Write for latest bulletins giving complete information on Ampco-Trode savings.

Ampco Metal, Inc. W-105
Dept. WJ-11, Milwaukee 4, Wisconsin
Field Offices in Principal Cities

a graduate of the University of Pittsburgh, receiving a B.S. in Electrical Engineering in 1931. After graduation he was Assistant Chief Engineer, National Casket Co., Pittsburgh; Manufacturing Engineer and Resistance Welding Specialist, Westinghouse Electric Co., East Pittsburgh and Resistance Welding Engineer at the Solar Aircraft Co. before assuming his present position with the same company.

The award is made annually for the best paper on resistance welding from an industrial source. Sponsored by the Resistance Welder Manufacturers' Assn. the contest offers a total of $2000 for papers which cover original and significant achievements in the field of resistance welding.

McCallian Regional Sales Manager

Bent Laune, President, All-State Welding Alloys Co., Inc., 96 West Post Road, White Plains, N. Y., recently announced that he has appointed R. J. McCallian to be Regional Sales Manager for All-State's line of low-temperature welding and brazing alloys and fluxes in eastern Pennsylvania, southern New Jersey, the entire states of Delaware, Maryland, Virginia and West Virginia and the District of Columbia.

Mr. McCallian came to his new position by way of welding apparatus sales. Previously for 10 years he worked as a metallurgist with the Carnegie-Illinois Steel Corp. of Gary, Ind. He is a graduate Chemical Engineer and has had postgraduate work at Purdue and Indiana Universities. He is a member of the New York chapters of the AMERICAN WELDING SOCIETY and the American Society of Metals.

Young Promoted

A. P. Young, acting head of the department of mechanical engineering at the Michigan College of Mining and Technology, has recently been promoted to the rank of professor, it has been announced by Dr. Grover C. Dillman, president of the college.

Professor Young joined the college staff in 1930 as assistant professor of mechanical engineering. He holds the B.S. degree in mechanical engineering from Purdue University and has completed the majority of his graduate work toward the master's degree. He is a member of the AMERICAN WELDING SOCIETY, the American Society of Mechanical Engineers, the American Society for Engineering Education and Tau Beta Pi.

OBITUARY

A. M. Unger

Arthur M. Unger, 41, Welding Engineer of the Chicago and Hammond plants of Pullman-Standard Car Manufacturing Co. died September 14th at St. Francis Hospital in Blue Island following a major operation.

Unger, who was a graduate of the Colorado School of Mines, had been associated with Pullman-Standard since 1935 and was widely known as an authority on production welding techniques. He played an important part in the company's development of welded railroad equipment to replace riveted cars.

He was a member and active worker in the Church of the Latter-Day Saints. Surviving are his wife, three daughters, his mother, three sisters and a brother. Burial was in Colorado.

Mr. Unger was an active member of the SOCIETY and delivered many papers before national and local meetings. He won several awards for best papers on resistance welding. He was also an active member of the Resistance Welding Research Committee.

Vincent P. Marran

Vincent P. Marran of St. Petersburg, Fla., formerly of Holyoke, Mass., and former president and general manager of the Walsh Holyoke Boiler Div., died on September 12th at the age of 60, following a short period of illness.

Mr. Marran had been connected with the Walsh Works for 32 years. He joined the company in 1912 and worked in the various departments of the concern until he became president and general manager. In 1944 he sold the firm to the Frankline Machine and Foundry Co., of Providence, R. I., and retired.

During the recent World War Mr. Marran served on Draft Board 78. Son of Martin and Elizabeth (Peel) Marran he was born in Sag Harbor, L. I., and received his early schooling there. He was a graduate of Pratt Institute, class of 1909.

Mr. Marran was a member of the AMERICAN WELDING SOCIETY and the American Society for Mechanical Engineers as well as the Holyoke Council Knights of Columbus. He helped organize the National Steelplate Fabricating Association.

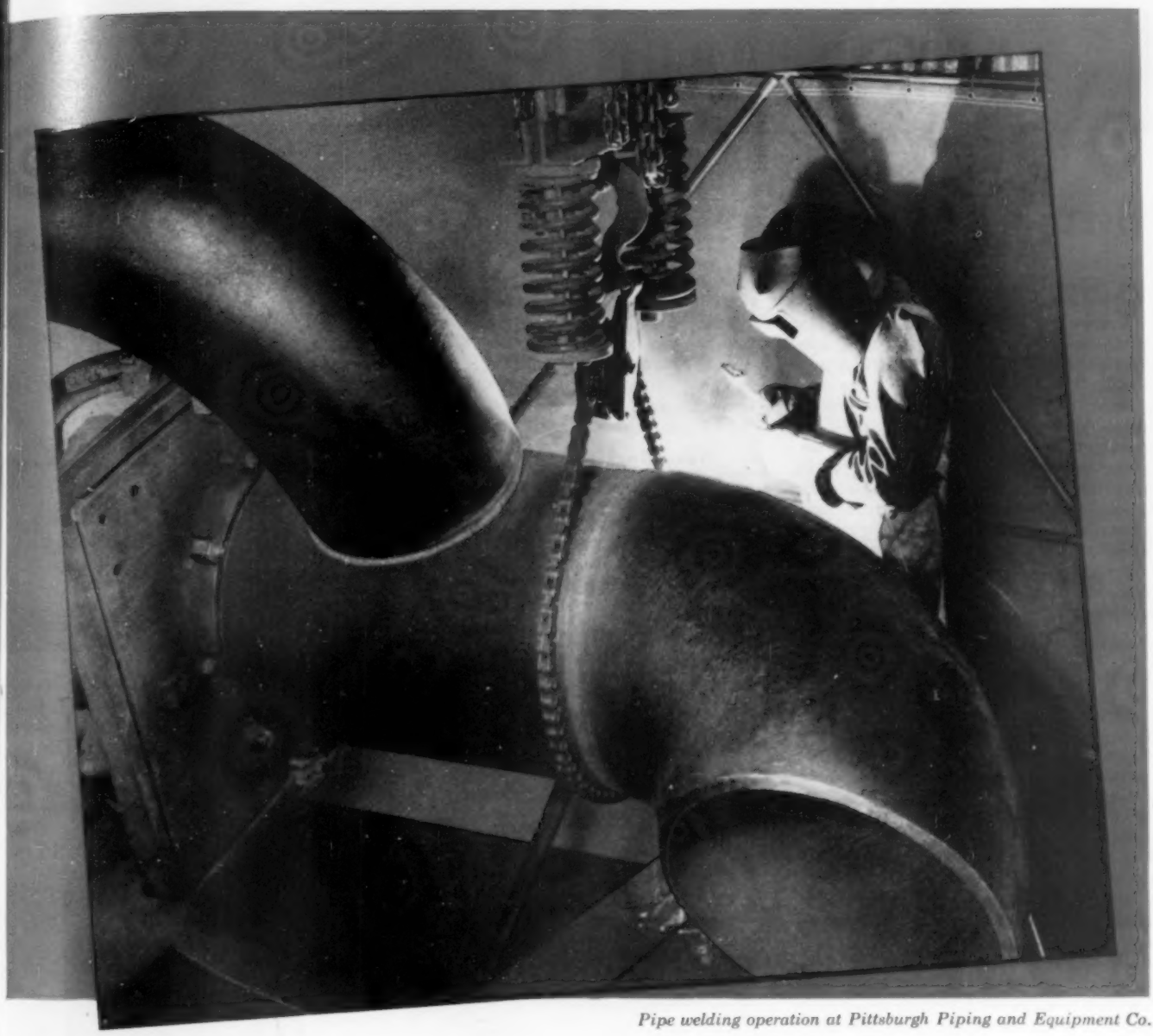
R. J. McCallian

A. M. Unger

DISCUSSION

Annual Meeting Papers Invited

Members desiring to present written discussion of Annual Meeting Papers should send these to the Editor of THE WELDING JOURNAL.



Pipe welding operation at Pittsburgh Piping and Equipment Co.

Correct alignment—easy assignment

WHEN the fittings line up perfectly with the pipe, fabricating a welded piping section like this is greatly simplified. And the Pittsburgh Piping and Equipment Company, in addition to providing modern facilities to make that job easier, used Tube-Turn welding fittings.

The uniform dimensional accuracy of Tube-Turn welding fittings assures swift, sure, accurate alignment. Their relatively light weight makes it practical to fabricate complete piping sections for later installation. Their forged-in strength and leakproof permanence mean piping that will require minimum maintenance, year after year.

To make the job easier, the results safer, equip that piping system with Tube-Turn seamless welding fittings. They are available in a wide range of types, sizes, metals and alloys. Your Tube Turns distributor carries a large stock. For good service in good connections, specify "Tube-Turn".

TUBE TURNS, INC.
222 E. Broadway, Dept. C, Louisville 1, Ky.

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

Write for the new and revised Tube Turns' chart of "Pipe and Fitting Materials". Covers ASTM and other specifications, chemistry, service temperature limits, welding data.

TUBE-TURN

WELDING FITTINGS AND FLANGES

NEW PRODUCTS

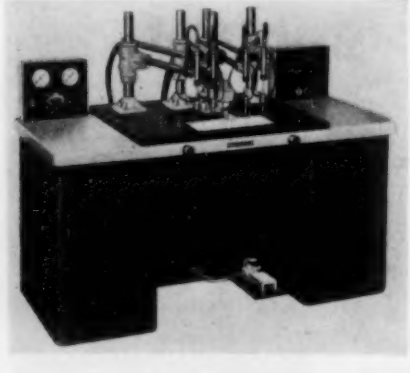
The Society assumes no responsibility for the validity of claims in this section

Electrode for Cast Iron

A new electrode, Hobart Nickelcast, is a 100% nickel electrode for producing machinable welds on cast iron without preheating the metal. The welds are machinable both in the deposit and line of fusion and may be drilled, tapped or machined at any point in the weld zone. Nickelcast is free from fluorides and will not produce injurious gasses. The coating is insulated to prevent arcing through when working in confined quarters. Nickelcast electrodes can be used with either a.-c. or d.-c. welding current and are available in $^{3}/_{32}$, $^{1}/_{8}$, $^{5}/_{32}$ and $^{3}/_{16}$ in. diameters.

Stud Welding Process

The basic principle of the Graham welder is a capacitor-operated, self-timed device using tip studs which, on coming in contact with the work and fusing, causes ionization; which, in turn, allows a path for the main discharge current of the capacitor to form an arc sufficient to melt both the full diameter of the stud end and the workpiece directly under same. This is followed by the necessary hammer blow causing the pieces to weld. This complete cycle is brought about by a rapid, continuous movement of the stud-holding part, no retarding means being employed. The time of arc is about one mil sec., which makes possible use of very high currents.



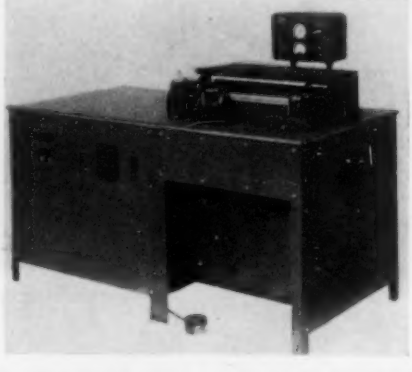
Some of the advantages of the extremely short arc time are the concentration of heat, the welding of studs on very thin metal, no fillets, no distortion of work, no discernible heat, allows studs to be welded on back of plated or painted surfaces without marring same, no flux is necessary, and makes possible welding of dissimilar metals.

Other advantages are: low energy consumption, small size of gun assembly allows ganging, can be used in any position, only one moving part in the gun and no skilled help is required.

Some of the metals and alloys welded by this process are: steel, stainless steel, Monel, aluminum, magnesium, zinc, copper and, in some cases, combinations of these metals and alloys.

New Magnetization Cuts Magnaflux Time 50%

Magnaflux Corp., has perfected an entirely new method of magnetizing parts in several directions at the same time which will be employed in a new line of Magnaflux Duovec inspection units. This method permits parts to be inspected for defects in any direction with one magnetizing operation and one visual inspection operation instead of the usual two or more magnetizations and inspections which have been required in the past.



The new Duovec system comprises the application of two magnetizing forces simultaneously. The parts are placed between the heads on the unit, where they receive magnetization in both directions during one shot while the inspection bath is being applied.

The type *MV* is one typical unit of the Magnaflux Duovec type. In the *MV* unit, a current is passed through the part as in normal circular magnetization. At the same time the part is subjected to a longitudinal field of regularly changing strength. The resultant varying magnetizing force swings through an angle within the piece of considerably more than 90° and thus cuts across all possible defects at right angles, as is required for best adherence of magnetic particles to form indications of the defects which can be easily seen.

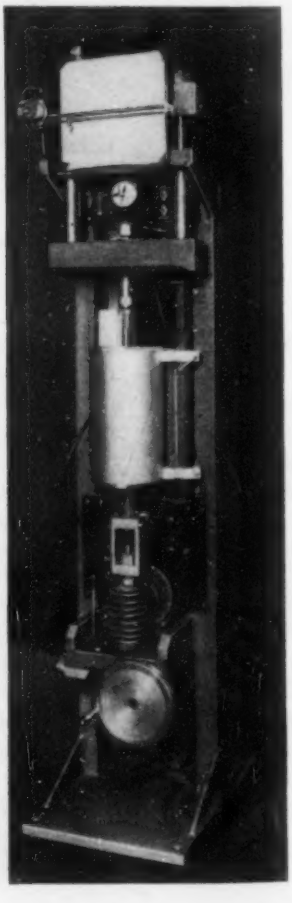
In these units the swing of the field may be adjusted from 0° swing to well over 90°, by changing the relation of values between the circular and longitudinal magnetizing fields. This type of magnetization is used with the fluorescent Magnaglo particles as well as the usual wet Magnaflux visible particles to obtain indications of defects in the parts.

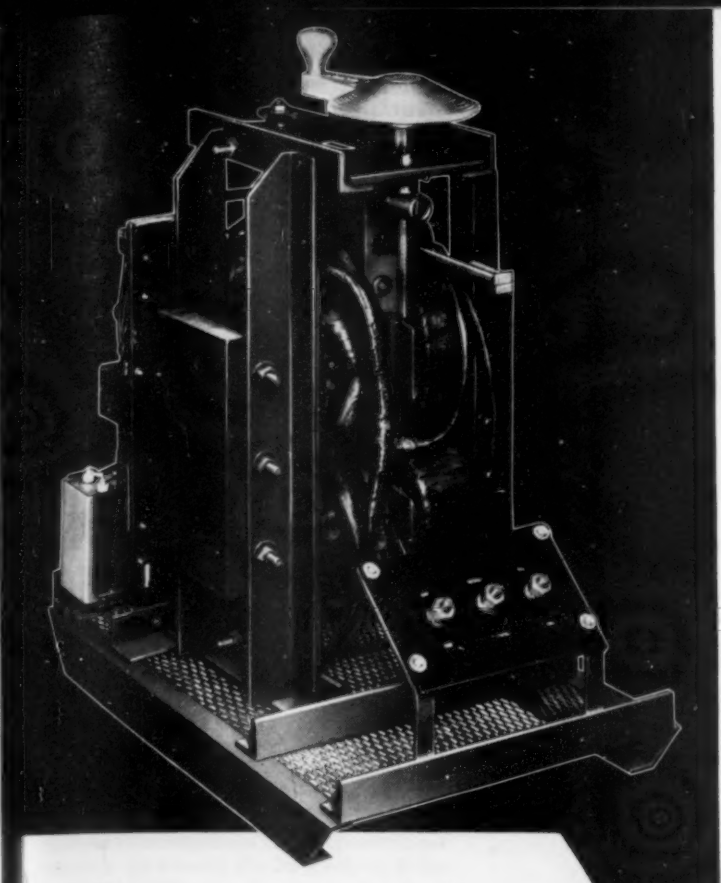
Inspection with the new Magnaflux Duovec is at present most applicable to the smaller parts which are substantially uniform in crosssection and are of essentially cylindrical or bar shape. This includes many parts made and inspected in high volume such as bolts, wrist pins, roller bearings, small gears, camshafts, etc. The Magnaflux Duovec unit with swinging field magnetization was introduced and seen in operation at the Magnaflux Corp. booth at the National Metals Exposition in Philadelphia, Oct. 25–29, 1948.

Creep Testing Machine

A new motor-driven, screw-type creep testing machine of 20,000 lb. capacity, designed for short-time, creep-rupture tests at high temperatures, with a minimum of operator attention, is announced by The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42. The machine automatically maintains constant loads up to 100,000 psi. on standard 0.505-in. diam. specimens while temperatures are held constant up to 2200° F. Tests of this type may run for 10 to 400 hr.

A feature of the machine is a flat 10- by 10-in. chart recorder panel in front, with which no extensometer is required and no strain readings need be made. This relieves the operator of giving much time and attention throughout the test and avoids drawing curves manually from recorded data. The elongation vs. time curve is automatically and accurately drawn on





No other line of welders has "*Powermaster*"—an exclusive, patented 4-coil transformer with a movable shunt . . . that assures fine welding characteristics at all amperages . . . that permits practical low-current welding . . . that gives the exact welding heat required . . . that gives the "push" that means faster burn-off, proper penetration and correct breakdown of usually hard-to-handle alloy rods.

with "POWERMASTER" a new and different welding feature!

This is the modern, *new* way to cut production costs!—Switch to NCG's new, better, different Sureweld A-C Arc Welder—with the exclusive "POWERMASTER". Working time per job drops, power consumption decreases, welding quality improves.

There are *19 reasons* why you, too, will prefer the new Sureweld A-C Arc Welder—just *too* many to recite here. You need a book—a free book called, "NEW ERA IN WELDING"—which you can get for the asking. Backed by NCG's pioneer experience in electric welding since 1920, distinguished by an entirely new NCG concept of design—the new Sureweld A-C Arc Welder merits your serious and immediate investigation.

Find out *now* the details of the seven Industrial Models, for high-speed, heavy-duty fabrication—and of the five Shop Models, for garages, repair shops, machine shops, farms, mills, factory and general repair use, for welding shops and light production work. Send *today* for the free illustrated Booklet, "NEW ERA IN WELDING" containing complete technical data.

NCG

EVERYTHING FOR WELDING

NATIONAL CYLINDER GAS COMPANY

Executive Offices:

840 North Michigan Avenue • Chicago 11, Illinois

Pioneers in Electric Welding since 1920.

Write for this FREE booklet today! Clip the coupon!

National Cylinder Gas Company
840 N. Michigan Avenue
Chicago 11, Illinois

Please send me free booklet, "NEW ERA IN WELDING", describing NCG's new, better, different Sureweld A-C Arc Welders—with the Powermaster.

Name .....

Firm .....

Street Address .....

City ..... **Zone** .... **State** .....

Position in Firm .....

Copr. 1948, National Cylinder Gas Co.

NEW PRODUCTS

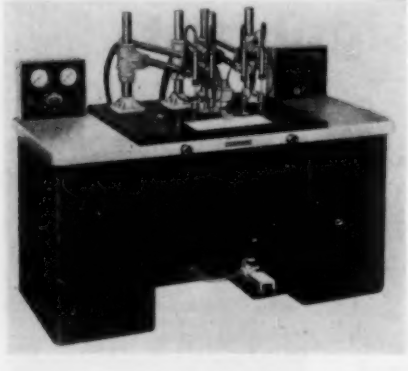
The Society assumes no responsibility for the validity of claims in this section

Electrode for Cast Iron

A new electrode, Hobart Nickelcast, is a 100% nickel electrode for producing machinable welds on cast iron without preheating the metal. The welds are machinable both in the deposit and line of fusion and may be drilled, tapped or machined at any point in the weld zone. Nickelcast is free from fluorides and will not produce injurious gasses. The coating is insulated to prevent arcing through when working in confined quarters. Nickelcast electrodes can be used with either a.-c. or d.-c. welding current and are available in $^{3}/_{32}$, $^{1}/_{8}$, $^{5}/_{32}$ and $^{3}/_{16}$ in. diameters.

Stud Welding Process

The basic principle of the Graham welder is a capacitor-operated, self-timed device using tip studs which, on coming in contact with the work and fusing, causes ionization; which, in turn, allows a path for the main discharge current of the capacitor to form an arc sufficient to melt both the full diameter of the stud end and the workpiece directly under same. This is followed by the necessary hammer blow causing the pieces to weld. This complete cycle is brought about by a rapid, continuous movement of the stud-holding part, no retarding means being employed. The time of arc is about one mil sec., which makes possible use of very high currents.



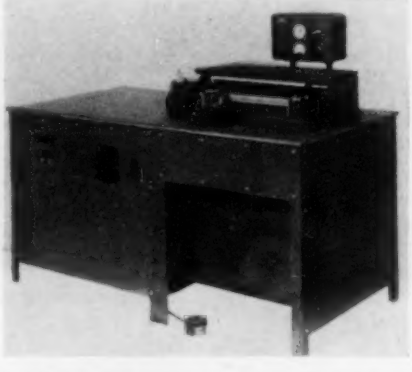
Some of the advantages of the extremely short arc time are the concentration of heat, the welding of studs on very thin metal, no fillets, no distortion of work, no discernible heat, allows studs to be welded on back of plated or painted surfaces without marring same, no flux is necessary, and makes possible welding of dissimilar metals.

Other advantages are: low energy consumption, small size of gun assembly allows ganging, can be used in any position, only one moving part in the gun and no skilled help is required.

Some of the metals and alloys welded by this process are: steel, stainless steel, Monel, aluminum, magnesium, zinc, copper and, in some cases, combinations of these metals and alloys.

New Magnetization Cuts Magnaflux Time 50%

Magnaflux Corp., has perfected an entirely new method of magnetizing parts in several directions at the same time which will be employed in a new line of Magnaflux Duovec inspection units. This method permits parts to be inspected for defects in any direction with one magnetizing operation and one visual inspection operation instead of the usual two or more magnetizations and inspections which have been required in the past.



The new Duovec system comprises the application of two magnetizing forces simultaneously. The parts are placed between the heads on the unit, where they receive magnetization in both directions during one shot while the inspection bath is being applied.

The type *MV* is one typical unit of the Magnaflux Duovec type. In the *MV* unit, a current is passed through the part as in normal circular magnetization. At the same time the part is subjected to a longitudinal field of regularly changing strength. The resultant varying magnetizing force swings through an angle within the piece of considerably more than 90° and thus cuts across all possible defects at right angles, as is required for best adherence of magnetic particles to form indications of the defects which can be easily seen.

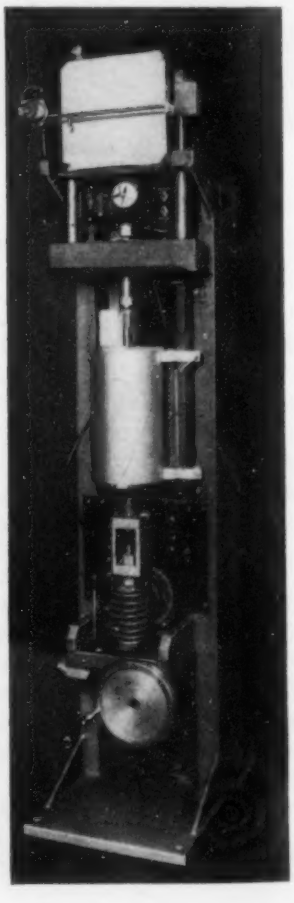
In these units the swing of the field may be adjusted from 0° swing to well over 90°, by changing the relation of values between the circular and longitudinal magnetizing fields. This type of magnetization is used with the fluorescent Magnaglo particles as well as the usual wet Magnaflux visible particles to obtain indications of defects in the parts.

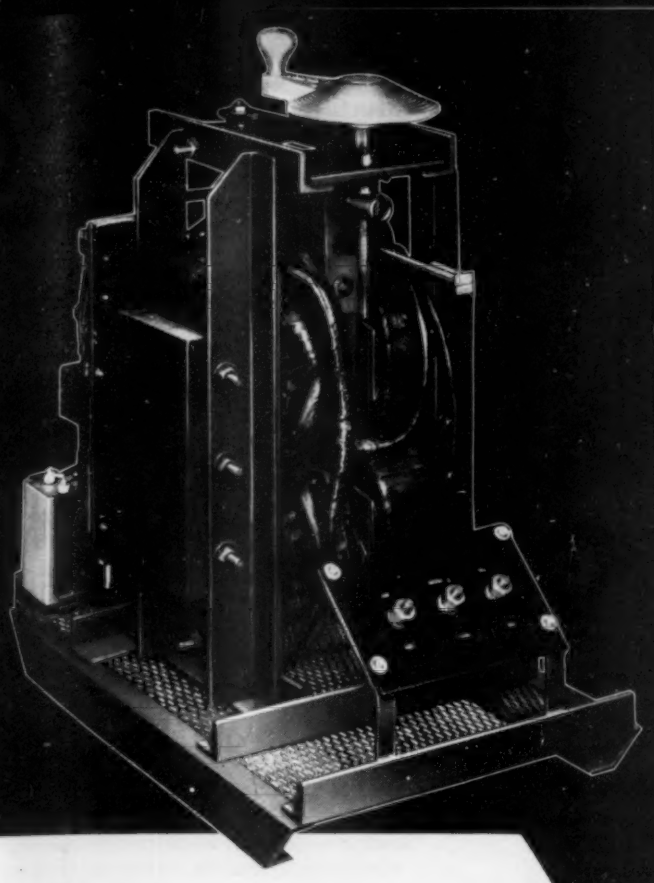
Inspection with the new Magnaflux Duovec is at present most applicable to the smaller parts which are substantially uniform in crosssection and are of essentially cylindrical or bar shape. This includes many parts made and inspected in high volume such as bolts, wrist pins, roller bearings, small gears, camshafts, etc. The Magnaflux Duovec unit with swinging field magnetization was introduced and seen in operation at the Magnaflux Corp. booth at the National Metals Exposition in Philadelphia, Oct. 25–29, 1948.

Creep Testing Machine

A new motor-driven, screw-type creep testing machine of 20,000 lb. capacity, designed for short-time, creep-rupture tests at high temperatures, with a minimum of operator attention, is announced by The Baldwin Locomotive Works, Testing Equipment Dept., Philadelphia 42. The machine automatically maintains constant loads up to 100,000 psi. on standard 0.505-in. diam. specimens while temperatures are held constant up to 2200° F. Tests of this type may run for 10 to 400 hr.

A feature of the machine is a flat 10- by 10-in. chart recorder panel in front, with which no extensometer is required and no strain readings need be made. This relieves the operator of giving much time and attention throughout the test and avoids drawing curves manually from recorded data. The elongation vs. time curve is automatically and accurately drawn on





No other line of welders has "*Powermaster*"—an exclusive, patented 4-coil transformer with a movable shunt . . . that assures fine welding characteristics at all amperages . . . that permits practical low-current welding . . . that gives the exact welding heat required . . . that gives the "push" that means faster burn-off, proper penetration and correct breakdown of usually hard-to-handle alloy rods.

with "POWERMASTER" a new and different welding feature!

This is the modern, *new* way to cut production costs!—Switch to NCG's new, better, different Sureweld A-C Arc Welder—with the exclusive "POWERMASTER". Working time per job drops, power consumption decreases, welding quality improves.

There are *19 reasons* why you, too, will prefer the new Sureweld A-C Arc Welder—just *too* many to recite here. You need a book—a free book called, "NEW ERA IN WELDING"—which you can get for the asking. Backed by NCG's pioneer experience in electric welding since 1920, distinguished by an entirely new NCG concept of design—the new Sureweld A-C Arc Welder merits your serious and immediate investigation.

Find out *now* the details of the seven Industrial Models, for high-speed, heavy-duty fabrication—and of the five Shop Models, for garages, repair shops, machine shops, farms, mills, factory and general repair use, for welding shops and light production work. Send *today* for the free illustrated Booklet, "NEW ERA IN WELDING" containing complete technical data.

NCG

EVERYTHING FOR WELDING

NATIONAL CYLINDER GAS COMPANY

Executive Offices:

840 North Michigan Avenue • Chicago 11, Illinois

Pioneers in Electric Welding since 1920.

Write for this FREE booklet today! Clip the coupon!

National Cylinder Gas Company
840 N. Michigan Avenue
Chicago 11, Illinois

Please send me free booklet, "NEW ERA IN WELDING", describing NCG's new, better, different Sureweld A-C Arc Welders—with the Powermaster.

Name.....

Firm.....

Street Address.....

City.....**Zone**....**State**.....

Position in Firm.....

Copr. 1948, National Cylinder Gas Co.

the chart from the start of the test until rupture occurs. It assures much greater accuracy at the final point of the curve, or for plastic strain at rupture, than has hitherto been possible by the conventional practice of measuring after rupture by fitting the two broken ends of the specimen together.

The recorder panel is driven vertically with the elongation of the specimen by the driving mechanism of the loading screw. The recorder pen is driven horizontally by a clock mechanism. Elongation is also indicated by a revolution counter which can be read directly in thousandths of an inch. It is operated by direct flexible shaft connection with the screw jack drive shaft. Change gears in the elongation drive to the recorder give 1, 2 and 4% elongations per inch.

The specimen is loaded below through gearing by means of a large, electric-motor-driven screw having a stroke of approximately 4 in. The top end of the specimen is supported by a stiff, heavy spring block on which the constant load is maintained by keeping a constant deflection. The deflection of the spring block is measured by a dial gage with an electrical contact. The electrical contact controls the motor that drives the screw. Thus, a constant deflection is maintained in the spring block and a constant load is applied on the specimen during its elongation. When the specimen ruptures, the control circuit (of which the specimen is a part), is broken and both motor and clock are stopped.

The new machine can also be adapted readily to short-time tensile tests, constant strain-rate tests, or relaxation tests. The machine weighs approximately 1200 lb., is 7 ft. high, and requires a 16- by 30-in. floor area.

Light-Weight Welder

A new light-weight, engine-driven, d.-c. welder, designed for a wide range of general applications, has been announced by General Electric's Welding Equipment Div. Weighing only 660 lb. for a maximum of 250 amps. of welding current, the new welder can be easily transported on a pickup truck, leaving ample truck capacity for other equipment.

It is powered by a Wisconsin VF-4 air-cooled engine, speed-ratio-coupled by a steel-core V-belt drive to a G-E Type WD-

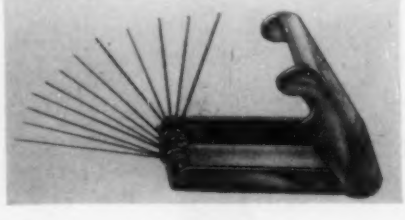
3200 generator with 50% duty cycle. A fully calibrated dual control permits the accurate setting of a desired welding current before the arc is struck.

The welder has a built-in auxiliary power outlet of 110 v. for the operation of lights and power tools, and stands on a full-length, rigid, welded steel base. The over-all length is 44 1/8 in., and it is 24 1/2 in. wide and 35 3/8 in. high. For greater portability, it can be furnished mounted on a two-wheeled, pneumatic-tired trailer with a standard 62-in. track.

Additional information about this new welder is given in Bulletin GEA-4886, available at the General Electric Co., Schenectady 5, N. Y.

Tip Cleaners

The Thermacote Co., 420 S. San Pedro St., Los Angeles 13, Calif., has redesigned the case containing the set of Thermo Tip Cleaners, making it smaller, lighter and as handy as the pocket in a shirt. The tip



cleaners also have been redesigned providing increased space between the cleaning ridges so that the carbon is removed without scratching the tip orifice, greatly prolonging the life of the welding tip and maintaining an efficient, clean-cutting flame at all times.

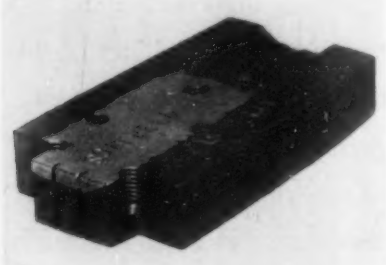
Machinable Welds in Cast Iron

The Lincoln Electric Co. of Cleveland, Ohio, announces a new electrode for welding cast iron. The new electrode is called Softweld and, as the name implies, is for depositing dense, soft machinable welds in gray iron castings. Softweld is a nonferrous electrode and operates with a soft steady arc on either alternating or direct current. Electrodes previously manufactured by Lincoln under the name Softweld have been discontinued.

The operating characteristics of the new Softweld bring a new ease to welding cast iron for machining. The electrode is designed to cause the weld to flow over and bond to the cast iron with a minimum of penetration and heating of the base metal. The deposit is smooth, dense and well feathered into the base metal. The entire weld area may be drilled, machined, sawed or tapped with ease. Its excellent operation on both straight and reverse polarity gives it a versatility in that it may be used either to build up an edge, in making such repairs as restoring broken gear teeth, or it may be used to fill in holes in defective castings.

Softweld is recommended for use both in original manufacture as well as repairing broken or defective castings and correcting machining errors. It is used for filling in sand holes and other surface blemishes; building up molds, repairing auto blocks and heads, valve seats, exhaust ports, furnace doors, pulleys, gears, sprockets, cast-iron dies, high nickel castings and dairy metals and for preparing castings in implement and machinery manufacture.

Softweld is available in the 14-in. length in 1.8 and 5.32 in. sizes, packaged in 10-lb. containers.



Deposit of Softweld on cast iron, readily cut, drilled and tapped in deposit and at line of fusion

Buy "PROVEN FLUXES"

Years of GUARANTEED SATISFACTION behind these GOOD

"ANTI-BORAX" FLUXES

Insist on them — Unequalled Quality

No. 1 Cast Iron Welding Flux
No. 2 Brazing Flux for Brass, Bronze, Steel, etc.
No. 4 Braz-Cast Flux for Bronze Welding Cast Iron
No. 5 & 8 Cast & Sheet Aluminum Fluxes
No. 9 Stainless Steel Welding Flux
No. 11 Tinning Compound
No. 16 Silver Solder Paste Flux

Mfg. By
ANTI-BORAX COMPOUND CO., INC.
Fort Wayne, Ind.

NET MONTHLY ADVERTISING RATES
Black and White — **Effective July 11, 1947**

Space	One Insertion	Three Insertions	Six Insertions	Twelve Insertions
*Full page	$185	$165	$150	$140
Two-thirds page	130	120	110	100
Half Page	105	95	85	80
Quarter Page	60	58	55	50
Eighth Page	40	35	30	28
*Inside Preferred	205	185	170	160

10% Extra for bleed full pages. Color $65 extra per color added

Agency Commission —15%
Cash Discount — 2%, 10 days

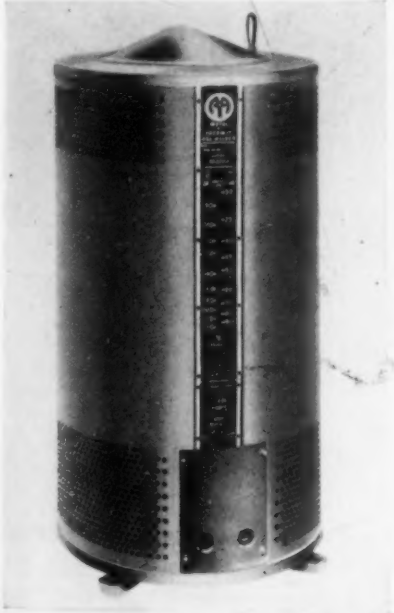
New Line of Arc Welders

Metal & Thermit Corp., New York, announces a new group of a.-c. and d.-c. arc-welding machines as a companion line to Murex electrodes and M & T welding accessories.

A.-c. unit features include built-in power-factor corrector; fingertip, stepless current control; fan-forced ventilation; wide current range and moderate open-circuit voltage operation. Units are of the transformer type, available in 150, 200, 300, 400, 500 amp. capacities.

These units also provide instant plug-in, plug-out of electrode leads by taper-type connector. Lead interchange is avoided by a permanent work lead connection. Running gear is available where portability is required.

Major design feature of all d.-c. models is a one-dial simplified control panel. The panel carries a series of well-marked outlets, each one for an electrode of different diameter. Operator simply plugs into proper outlet, then dials for any required minor adjustment in current.



Motor-driven d.-c. units are available in 150, 200, 300, 400 amp. capacities in new compact 3600 rpm. model and in conventional 1750 rpm. type. Engine-driven welders include 200-amp. units powered by air-cooled Wisconsin engines, and 300- and 400-amp. sets driven by Chrysler industrial engines.

The new machines will be distributed through Metal & Thermit district sales offices and through distributors handling Murex electrodes.

Facing Electrodes Announced

The Lincoln Electric Co., of Cleveland, Ohio, has added to its hard-facing line two new tubular type shielded-arc electrodes: Faceweld No. 1 and Faceweld No. 12. Electrodes previously manufactured under the name Faceweld have been discontinued in favor of the new tubular electrodes which provide a higher consistency to the deposited alloy and a much lower cost.

Faceweld No. 1 deposits a chromium carbide type alloy surface and is used for hard facing parts of plain carbon, low-alloy or manganese steel. It is designed to resist severe abrasion as well as moderate impact. Deposits of single layer have hardness of 40 to 52 Rockwell C. Multiple layer beads have hardness of 52 to 60 Rockwell C.

Faceweld No. 12 is an electrode of the same type as Faceweld No. 1, but is designed for use where the hard-faced surface must withstand extremely severe abrasion as well as some impact. The deposit is harder but not as tough as that of Faceweld No. 1. Single layer deposits have hardness of 45 to 55 Rockwell C. Multiple layer deposits hardness is 55 to 64 Rockwell C.

The deposits of both No. 1 and No. 12 maintain high abrasion and hardness values at red heat. Their corrosion resistance is comparable generally to that of stainless steel. The electrodes operate on either alternating or direct current.

Faceweld No. 1 and No. 12 are available in 14-in. lengths in $^5/_{16}$- and $^3/_{16}$-in. diam. sizes, packed in 10-lb. containers.

Hard Facing Alloys

Stoody Co., Whittier, Calif., announces two new hard-facing alloys especially engineered for added wear protection on heavy equipment. These are Stoody Self-Hardening 21 for applications involving extreme abrasion with moderate impact, and Stoody 1027 for severe impact with moderate abrasion. They are recommended for such equipment as tractor parts, power shovels, crushers, impellers, mechanical loader lips, etc.

With the variation in characteristics obtained with the new Stoody Self-Harddening 21 and Stoody 1027, problems involving severe impact or abrasion can be specifically treated, with considerable advantage in increased life and lower maintenance.

Both alloys are in the low-cost group and each has been carefully field-tested for over a year. Composition and characteristics follow.

Stoody Self-Hardening 21

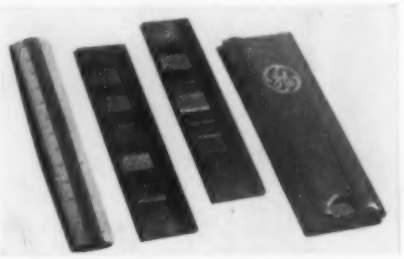
High alloy, fabricated tubular construction; alloys include chromium, manganese, silicon, carbon and zirconium. Possesses highest abrasion resistance of any alloy in low-cost group with good impact strength. Primarily recommended for down-hand application. Furnished bare and coated. Approximate Rockwell "C" hardness of deposits, 55.

Stoody 1027

Low-cost rod having mild steel core wire with all alloys contained in heavy, extruded, graphite type coating. Composed of chromium, manganese and carbon. Possesses high impact strength with good wear resistance. Approximate Rockwell "C" hardness of deposits, 45.

Pocket-Size Surface Roughness Scales

A new pocket-size surface roughness comparator for sight and feel comparison with machined finishes has been announced by the General Electric Special Products Div.



Known as the Surface Roughness Scale, the new comparator is composed of two small metal rules 6 in. long and $1^1/_4$ in. wide. These illustrate degrees of roughness ranging from the smoothness of a bearing surface to the roughness of a flame cut.

One side of each scale is divided into 12 surfaces, depicting a total of 24 different surfaces which are grouped into 10 degrees of surface roughness. Every degree is identified by a number which designates the nominal roughness in micro-inches (average).

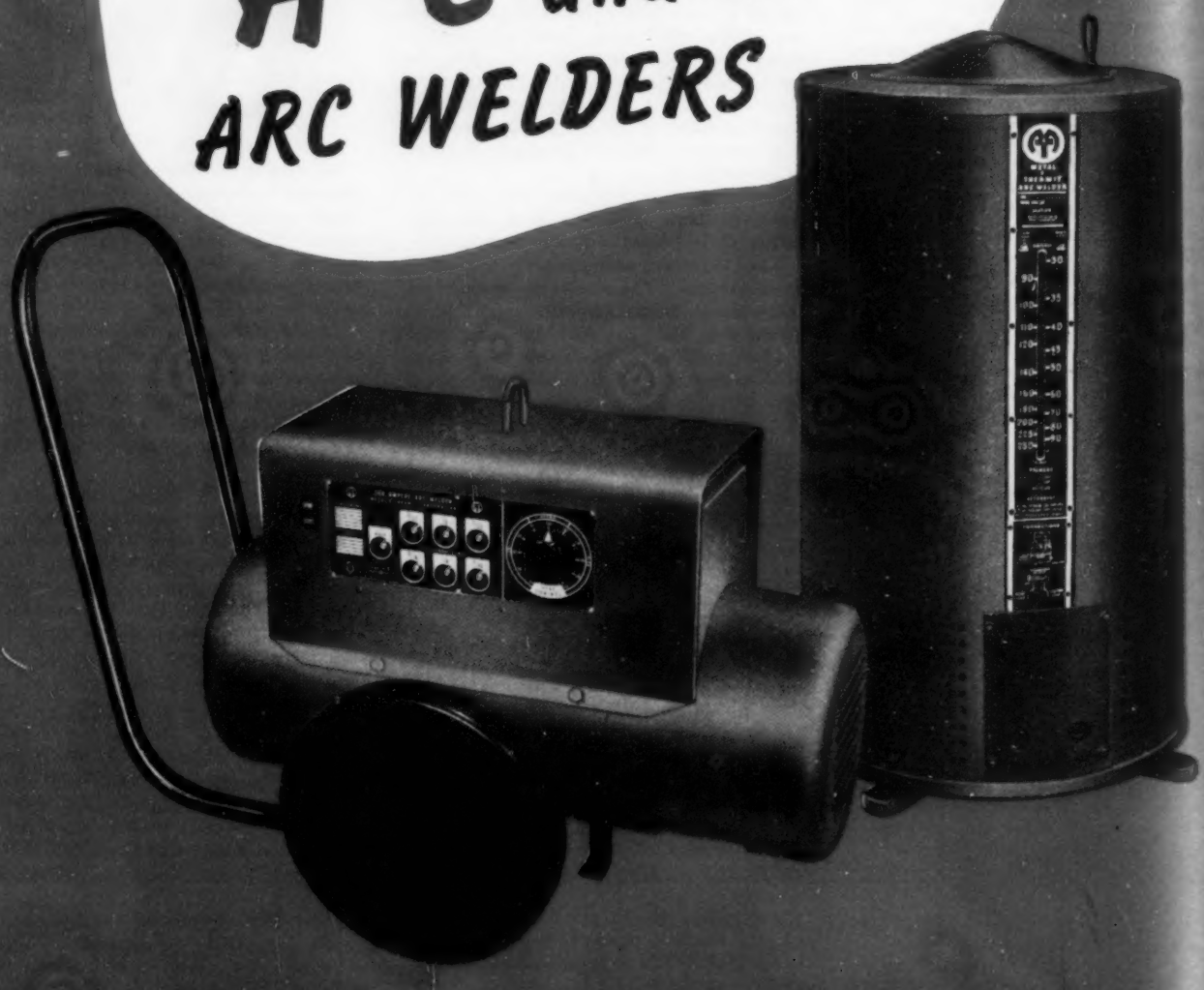
Weighing only 3 oz., including the leather case, the comparator enables engineers and draftsmen to visualize, select and specify surface characteristics for production work and machine operators and inspectors to determine by sight and feel comparison whether surfaces meet designated specifications.

Welding Electrodes

A new type of manual arc-welding electrode, designed to improve weld quality while lowering welding costs, was displayed for the first time at the National Metal Exposition in Philadelphia, October 25–29, by North American Philips Co., Inc., N. Y.

These new electrodes, available in lime ferritic, iron oxide and organic types, have a special type of coating and offer certain definite advantages. Training time for inexperienced welders is shortened and less expensive quality control is required. High deposition rates and efficiencies result in lower costs per foot of weld joint. Operator fatigue is reduced and a higher production rate per unit of time is obtainable. These new type Norelco contact welding electrodes, two of which can also be used on a semiautomatic basis, permit touchwelding in all welding positions except vertical up and have automatic starting and re-igniting properties. They deposit weld metal of the highest mechanical properties and have deposition rates from

M&T PRESENTS a COMPLETE LINE of A-C and D-C ARC WELDERS



Up-to-the-minute companions to
Murex Electrodes and M&T Welding Accessories

Engineered to Step Up . . .
QUALITY, SPEED and ECONOMY in
Both A-C and D-C Arc Welding

M&T A-C ARC WELDERS

M & T a-c welders are designed to give you the utmost of every advantage of a-c welding — *faster welding, better quality welds, lower power costs, less maintenance, and almost silent operation!* Available in 100, 200, 300 and 500 ampere ratings for manual arc welding; in additional models for inert arc and automatic welding. Transformer type with welding current controlled by a movable coil.

Outstanding design features include BUILT-IN CAPACITORS which insure a high power factor and result in low operating cost . . . FINGERTIP, STEPLESS CURRENT CONTROL to permit precise adjustment of welding current . . . WIDE CURRENT RANGE and enough overtravel to allow full rated output with long welding leads . . . FAN VENTILATION to assure safe, cool operation of the 300 and 500 ampere units.

M&T D-C ARC WELDERS

M & T d-c welders are newly engineered throughout. Compact, lightweight — only half as big and half as heavy as older types of machines — they are full capacity, heavy duty industrial units ruggedly built to give long, dependable service with a minimum of maintenance. Sets of 150, 200, 300 and 400 ampere capacity are available in motor-driven, engine-driven, and belt-drive models.

SIMPLIFIED CONTROL, a feature of all M & T d-c machines, permits precise current setting in a jiffy. Simply plug the electrode lead in the proper panel outlet, set the single dial for any required minor current adjustment and you are ready to weld!

Want more information on M & T welding machines? Write for bulletin!

METAL & THERMIT CORPORATION

120 Broadway • New York 5, N. Y.

ALBANY • CHICAGO • CINCINNATI • CLEVELAND • HOUSTON • MINNEAPOLIS
NEWARK • PHILADELPHIA • PITTSBURGH • SO. SAN FRANCISCO • TORONTO

MUREX WELDING ELECTRODES
M&T ELECTRODES AND GAS RODS
M&T ARC WELDING MACHINES
M&T WELDING ACCESSORIES

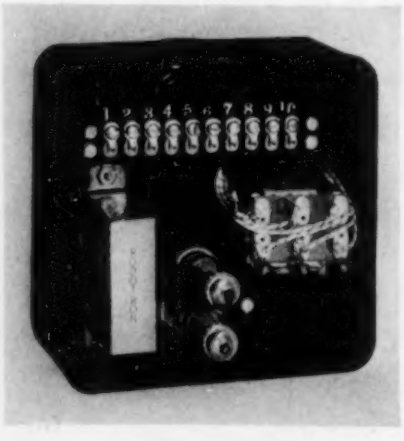
25 to 100% higher than those of standard type electrodes.

These electrodes offer high deposition efficiency because of their low spatter losses and special coating. The special type of penetration obtained considerably decreases the possibility of undercutting. Standard size joints can be made with fewer layers as more weld metal per pass is obtainable.

The electrodes work satisfactorily with standard welding equipment on a.c. or d.c., reverse or straight polarity. Very high currents, up to 600 amps. for the 5/16 in. size, may be used.

Robotector

The Robotector is designed to be installed on any type resistance welding equipment and receives its power and initiation from the weld timer. It is small, light in weight and easily installed. The device's primary purpose is to automatically protect the idle welding transformer from condensation and eventual electrical failure; secondly, saves on water flow; thirdly, reduces sweating, rust, corrosion, and mineral deposits.



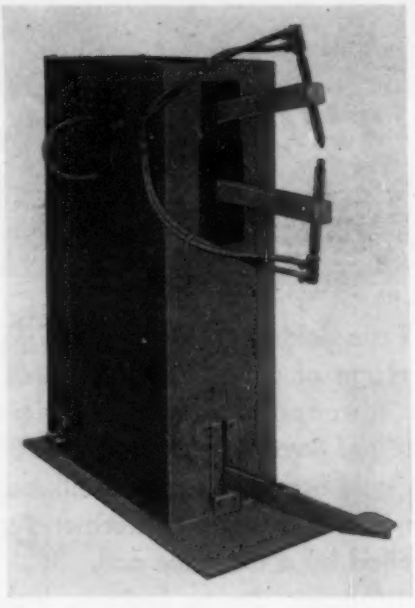
The Robotector is an electronic "Fail-Safe" 1 1/2-minute interval timer. It is initiated through a relay contact or switch located in the customer's weld timer. The device contains two 2D21 thyratron tubes and a three-pole normally open 10-amp. contact relay. The unit is installed in an attractive black crackle-finished box. All external connections are made to a terminal strip mounted on a chassis inside of the box. The Robotector is manufactured, by the Robotron Corp., 56 Manchester Highland Park (Detroit) 3, Mich.

New Line of Spot Welders

Electric-Arc, Inc., of Newark, N. J., announces the availability of its new line of electro-weld spot welders for fast, economical production.

The equipment illustrated is a heavy-duty unit featuring 8-step current control permitting 75% secondary voltage adjustment.

The electrodes are standard size, water cooled and easily and quickly renewed. The equipment features a spring-loaded foot switch, ample ventilation and arc-welded steel casing with removable top and rear door for ease of inspection.



The equipment operates on 220-v. 60-cycle single-phase alternating current. If desired, these units can be furnished with magnetic contactors and weld timers.

A complete, illustrated catalog sheet with specifications may be had by writing Electric-Arc, Inc., 152–162 Jelliff Ave., Newark 8, N. J. This company not only produces a line of standard electro-weld spot welders, but is also in a position to develop special designs for special applications depending on the problems incurred in each industry. For more than 30 years Electric-Arc has pioneered in the design and production of electrical equipment and is qualified by virtue of this experience to assist industry with any welding problem.

A.-C. Welder

The new Sureweld A.-C. Welder, in models for both shop and industrial use, has been announced by the National Cylinder Gas Co., Chicago.

The new Sureweld is made in 12 models, of which seven are for high-speed, heavy-duty fabrication, and five are for duty in garages, repair shops, machine shops, mills, welding shops and wherever light production work is carried on.

Among the many advantages found in the models are two NCG exclusive features, the four-coil transformer with moveable magnetic shunt, which assures fine welding characteristics at every point within the output range; and correct ratio of open circuit to arc voltage, a provision that means faster burn-off, proper penetration and correct breakdown of usually hard-to-handle alloy rods.

Efficiency of operation is provided for by a stepless full range output control, which gives the precise welding heat needed. Truly low-current welding is established by Sureweld's exclusive high reactance windings, which give added reactance and sustain proper open-circuit voltage even at lowest output settings.

Optional controls are available on the industrial models to meet special problems. Where frequent power shutoffs are desirable, as when considerable jig or fixture time is required, an on-and-off power control consisting of a primary contactor and a choice of three switches is recommended. For situations in which the welder can be stationed in an out-of-the-way spot, as an overhead balcony, amperage remote control also is available.

The shop units are easy to handle and easy to move, large rubber-tired wheels and towing tongue providing maximum portability.

An illustrated booklet describing the new Sureweld in detail has been published by NCG, and may be obtained by writing to the company at 840 N. Michigan Ave., Chicago 11, Ill.

Wire Control and Straightener Unit

A new Wire Control and Straightener Unit is announced by the Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, N. Y.

The METCO Type 2W-Wire Control and Straightener Unit is superior in appearance, efficiency, construction and convenience to any previous units.

New and outstanding features include: (1) All metal construction to give stability and rugged, continuous trouble-free operation. (2) Outer metal hoop keeps the coil on the reel and prevents the wire from "riding off," or getting tangled under the arms. Adjustable to accommodate any size coil. Handles 3/16-in. wire easily and efficiently. (3) Ball Type Thrust Bearing makes it free-running and eliminates all unnecessary drag from reel top. (4) All adjustable parts equipped with thumb screws for quick and easy adjustment. Easy-to-reach brake to adjust reel top tension. (5) Easily assembled in 10 min. (6) Easily adapted to mounting on automatic set-ups, bench or other desired place. (7)The straightener unit is efficient and adjustable. Wire moves on sealed grease-packed, ball-bearing rollers. Unreels wire in proper direction and removes curvature from any type or any size metallizing wire, regardless of stiffness. One easy adjustment feeds the wire in any desired direction.

For faster spraying speeds and less damage to gun parts, ask for the METCO Type 2W-Wire Control and Straightener Unit.

Electrode with Low Hydrogen Coating

A new electrode, "Hobart No. 90-PL," is a low hydrogen coated electrode designed for welding high carbon, high sulphur and other hard-to-weld steels without underbead cracking. The absence of underbead cracking is achieved by a special low hydrogen coating. This electrode has a smooth and steady arc insuring good root penetration. Deposited weld metal is sound with high ductility. Physical properties of this electrode are: tensile strength 94,000 lb. psi., yield point 85,000 lb. psi., and 26% elongation in 2 inches. Hobart No. 90-PL is available in 3/32 in., 1/8 in., 5/32 in., 7/32 in. and 1/4 in. diameters for use with D-C welding current only.

Now.. MATCHED ENCLOSURES

for
RESISTANCE WELDER CONTROLS

PART OF THE PARADE OF NEW DESIGNS

New Safront Timers and SYNCRO-BREAK Contactors Give You These 4 Important Advantages:

1 MOUNTING CONVENIENCE—Dimensions are standardized so timers and contactors may be mounted together in the four ways illustrated. Knockout mounting holes in left side and back permit timer installation with adjusting dials facing operator.

2 LOW INSTALLATION COST—Identically-located knockouts permit close coupling of enclosures, eliminating need for conduit run between contactor and timer.

3 NEAT APPEARANCE—Choice of mounting arrangements with matched units permits convenient installation on any machine. When mounted one above the other, the two enclosures will appear as one.

4 OPERATOR SAFETY—Foot switch, pressure switch, no-weld switch and timer-control circuits are 110 volts. Safront timer has adjusting dials on front of removable swing-out panel, with electrically live parts on rear.

NEMA TYPE 3B and 5B TIMERS have enclosures of identical dimensions, dual (220/440 volt) primary control transformers, and space for 24 volt and/or two-stage foot switch control features.

PNEUMATIC TIMER UNITS are now more accurate and dependable than ever, using new Square D precision snap switch contact mechanisms, ribbed mounting plates, and fewer moving parts.

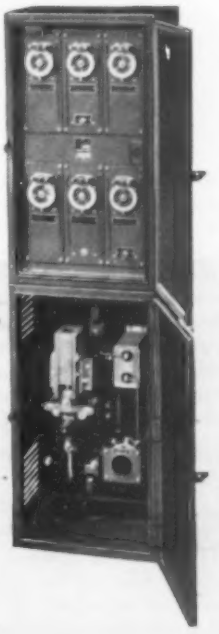
SYNCRO-BREAK CONTACTORS in sizes 1W and 2W have enclosures identical in size with the timers. Synchronizing circuit eliminates arcing to prolong life and reduce maintenance.

Machine Mounting—
Timer above contactor.

Machine Mounting—
Contactor behind timer
(Swing-out panel removed)

Wall Mounting—
6-period timer
above contactor

Wall Mounting—
4-period timer
beside contactor



***Write** for Complete Details. Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.*

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D CANADA, LTD., TORONTO, ONTARIO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

Phosphor Bronze Electrodes

All-State Welding Alloys Co., Inc., White Plains, N. Y., announces the immediate availability through All-State distributors nationally, of a new Phosphor Bronze Electrode for the metallic arc welding of copper, tin bronzes, brasses, cast and malleable iron, galvanized iron and dissimilar metals.

This new electrode is recommended for bearing and corrosion resistant applications, and for general maintenance and repair welding. Welds made with it have a tensile strength of more than 40,000 psi. and a Brinell hardness of 70–80. The deposited weld metal is very dense.

Known as All-State No. 22 Phosphor Bronze "A" (Arc), this new electrode is available in a range of sizes, including $^{3}/_{32}$, $^{1}/_{8}$, $^{5}/_{32}$ and $^{3}/_{16}$ in.

Hard-Facing Rods

Two new iron-base hard-facing rods—Haynes 90 and 92 alloys—have recently been developed by Haynes Stellite Co., Kokomo, Ind. Haynes 90 rod is highly resistant to conditions of impact, abrasion and heat. It also has excellent resistance to oxidation at temperatures up to 1000°F.

Haynes 92 rod is a moderately low melting point, hard-facing material that is resistant to the most severe abrasion. This alloy is especially suitable for applications where a low temperature deposition is necessary to prevent distortion of the base metal. It is not recommended for use where highly corrosive conditions or elevated temperatures are encountered.

Recommended Uses

Haynes 90 rod will find its most important field in hard facing wearing parts on earth-moving machinery and equipment used for crushing and handling hard, farible material such as sand, slag, coke, limestone and coal. Parts successfully hard faced with this alloy include shredding machine parts, clam shell buckets, lifting hooks, chain links, cement guns, clay mixers, pug mills, crusher rolls and pump plungers. The life of such parts is increased as much as six or more times by protecting them with Haynes 90 rod.

Haynes 92 rod is suitable for hard facing massive parts where little or no preheating is practicable, and for thin sections, such as fan blades where the low fusion temperature minimizes warpage. It has also been used with marked success on the wearing edges of pug-mill paddles—increasing their service life 10 to 1. Wear plates in shot blast machines hard faced with this rod outlast unprotected plates by about 12 to 1.

Available Forms

Both Haynes 90 and Haynes 92 rods are supplied as bare rod for application by the oxyacetylene process and coated electrodes for metallic-arc welding.

---

abstracts of CURRENT WELDING PATENTS

prepared by V. L. Oldham

Printed copies of patents may be obtained for 25c from the Commissioner of Patents, Washington 10, D. C.

2,447,955—Arc Welding System—Raymond A. Millholland and Wilbur F. Sully, Indianapolis, Ind.

This patent covers a method of controlling a single-phase alternating arc wherein two transformers are used and the primary windings of the transformers are connected in series and the secondaries of the transformers are connected in series with the voltages in the secondaries being unequally divided in a predetermined ratio. A third conductor is connected in the secondary circuit of one of the transformers and utilized only for work preheating purposes.

2,448,089—Torch Cutting Machine—Samuel Duvall, Highland Park, Mich., assignor to Air Reduction Co., Inc., a corporation of New York

The machine covered in this patent is specially adapted for cutting round metal stock and it includes a torch-supporting arm which is mounted for pivotal angular movement about an axis extending lengthwise of the work piece, and a torch holder is pivotally connected to such arm so that it can swivel with respect thereto about an axis parallel to the first-mentioned axis. A torch is mounted on the torch holder and special means connect the torch holder to a mounting base so that pivotal angular movement of the arm on its axis moves the torch abouts its positioning axis in a desired manner.

2,448,098—Method of Thermo-Chemically Cutting Metal—Howard G. Hughey, Fanwood, N. J., assignor to Air Reduction Co., Inc., a corporation of New York

The thermo-chemical cutting action disclosed in the above-identified patent is adapted for cutting through metal workpieces of heavy section. The method comprises the alternate steps of heating the metal at the place where the cut is to begin to a temperature at which the metal will burn when cutting oxygen is projected thereagainst after which cutting oxygen is projected onto the preheated workpiece at such heated place to burn a portion of the metal therefrom. Thereafter alternately and with rhythmic frequency the heating flame and cutting oxygen are projected against further portions of the metal workpiece.

2,448,107—Method and Apparatus for Making Welded Pipe Joints—John D. Mattimore and Fred C. Smith, Louisville, Ky., assignors to Tube Turns, Inc., a corporation of Kentucky

This new type of a welding method relates to one for butt welding the ends of tubular members wherein a welding ring is positioned within the tubular members and extends into each such member adjacent the substantially abutted end portions of the tubular members. Spacer devices are also positioned intermediate the adjacent ends of the tubular members with the ends of such members abutting thereagainst. The ends of the members are then progressively welded together with the spacer devices being removed prior to the welding operation at the location of such spacer to avoid incorporation of the spacer in the welded joint and permit re-use of the spacer.

2,448,690—Apparatus for Bonding Wear-Resistant Facing Elements to Machine Elements—Herbert F. Storm, West Allis, Minn., assignor to Sunbeam Corp., a corporation of Illinois

The use of a high-frequency magnetic field is disclosed in this patent for apparently fusing facing elements to a rotary tool bit.

2,448,694—Electric Welding Apparatus—John M. Tyrner, New York, N. Y., assignor to Air Reduction Co., Inc., a corporation of New York

Tyrner's construction relates to the

drive used for controlling relative motion between the work and the electrode and it includes variable speed driving means for producing such motion and including a drive shaft and a counter shaft which are so associated that the countershaft moves at a speed corresponding with normal welding speed for a portion of the time and then also is intermittently moved at a higher speed by a second driving action supplied to such countershaft.

2,448,697—Welding Glove—Robert Bakke, Minneapolis, Minn.

Bakke's glove includes a strip of flexible material interposed between the back and palm portions along the forefinger side of the glove, and a fireproof shield is secured to such flexible strip to overly the back of the glove to provide a protective covering for the back of the glove against sparks and bits of molten metal.

2,448,865—Dental Welding Machine—Nicholas Crombach, San Francisco, Calif.

This special welding device includes one stationary electrode and one electrode which is pivotally positioned and normally is parallel to the stationary electrode. A bell crank lever is connected to the pivoted electrode and has a control plate secured thereto whereas spring means normally maintain the bell crank lever in a position to retain the pivoted electrode adjacent to the stationary electrode but wherein movement of the control plate will move the pivoted electrode away from the stationary electrode.

2,448,994—Welding Rod Holder—Archie W. McClary, Oakland, Calif.

The welding rod holder of this patent includes a fixed electrode engaging jaw, and a flexible resilient working arm disposed in association with such jaw and carrying an opposing jaw for the welding rod holder. A member secures the resilient working arm in position and permits pivotal movement thereof and a lever is provided for controlling the position of the resilient working arm.

2,449,082—Method of Preventing Distortion in Butt-Welded Plates—Louis P. McCabe, Hollis, N. Y.

McCabe's welding method comprises beveling the facing surfaces to be welded so that such surfaces subtend an angle of between 15 and 45° and interposing against such adjacent beveled faces a wedge whose subtended angle is greater by three to five degrees than the angle subtended by the beveled surfaces, and applying a force against the butt of the wedge carrying the welding process.

2,449,220—Cooling Nozzle for Use in Welding—Ronda C. Gupton, Newport News, Va.

The nozzle disclosed by this patent has an inlet end and a diffusing chamber at the outlet end with the cross-sectional area of the connecting casing being gradually reduced toward the discharge end. An inlet fitting is provided at the inlet end of the casing and openings are provided in the inlet ends adjacent the inlet fitting through which air can be drawn into the casing by fluid from the inlet fitting passing through the casing.

2,449,370—Electrode Holder—Thomas S. Donnelly, Detroit, Mich.

Donnelly's holder includes movable gripping jaws having portions of substantially semicircular cross section and insulating members which also have an outer surface of substantially semicircular shape mounted on and covering such portions of the electrode holder jaws.

2,449,371—Methods and Means for Welding Pipes and the Like—Emery Dutch, New York, N. Y.

A tool for protecting and keeping smooth the inside of a welded portion of the end of two pipes placed adjacent to, but spaced apart, from one another is covered in this patent. The tool includes a plate which is adapted to be passed edgewise between the adjacent ends of the pipes and be brought into association with the inner surface of the pipes and which can be retained in position by means external of the pipes and be thereafter shifted with relation to the pipes or else withdrawn from engagement therewith by moving such plate in an edgewise manner between the adjacent end portions of the pipes.

2,449,455—Adapter for Spot Welding Machines—Ernest Crabtree, Toronto, Ontario, Canada

Crabtree's adapter includes a body having a clamp designed to fasten on an electrode arm of a conventional machine and disk means rotatably mounted in the body. An electrode holder may be mounted in the disk means and the disk and holder are adapted to be fixed in a given adjusted position with the disk and welding electrode at a predetermined distance from the adjacent portions of the body of the adapter.

2,449,456—Arc Welding Control System—Charles P. Croco, Buffalo, N. Y., and John H. Blankenbuehler, Troy, Ohio, assignors to Westinghouse Electric Corp., East Pittsburgh, Pa., a corporation of Pennsylvania

The arc-welding system covered in this patent includes a line switch which normally connects the welding circuit to a reduced voltage source and which can be energized to connect the welding circuit to a circuit of arc-welding voltage. Switch means connect to and operate upon engagement of the electrode and the work to energize the line switch. The switch means are reconnected by the line switch to maintain such switch means energized.

2,449,521—Soldering or Welding Implement—Samuel W. Warner, Newark, N. J., assignor of one-half to Herman Bernstein and one-half to Joe Sodowick, Newark, N. J.

Warner's patent covers an implement of a shape and size so that it may be held in the hand like a pencil in writing. The instrument includes a pair of tubular arms which have flattened portions near their rear ends and with tubular sockets for receiving wire ends also provided at the rear ends of the tubular arms. Electrodes are removably positioned in the forward ends of the tubular arms which are secured together at the flattened portions thereof which are insulated from each other at such portions of the arms.

2,449,649—Welding Transformer—James Donovan Forney, Fort Collins, Colo.

The transformer disclosed in this patent has a primary and a secondary core with a magnetic shunt being connected about the secondary core and having an air gap therein. A drum has a threaded member made of magnetic material positioned in engagement with the magnetic shunt and extending into the air gap thereof. The drum has two connectors secured thereto and wound therearound whereby the drum can be rotated in either direction by means of the conductors to vary the action of the magnetic shunt.

2,449,677—Welding Rod Feeder—Paul H. Setzler, Hamilton, Ohio

This welding rod feeder includes a base and a welding rod holder which engages one end of a welding rod and sustains the rod at a fixed angle to the work surface. A vertically positioned post engages with and guides the holder for feeding the rod downwardly by gravity and an electrode operated post engaging device regulates the descent of the holder as the weld rod is deposited upon the work.

2,449,707—Welding Mechanism—Chester F. Leathers, Detroit, Mich.

The mechanism of this patent includes a portable welder and a hanger for mechanically supporting the welder. This hanger includes bus-bar means through which power is delivered to the welder and means for adjustably supporting the welder from the hanger.

2,449,754—Fitting for Connecting Pipes by Welding—Oskar Seitz, Baden, Switzerland

The fitting disclosed in this patent includes at least one integral extension nipple at one end and formed of a substantially tapering shape. The extension nipple has several severable sections each having a diameter at a point of demarcation corresponding to a standard pipe size so that by severance of any selected one section an end surface will be provided of a diameter appropriate for connection by welding to a pipe end of corresponding diameter.

2,449,766—Apparatus for Relieving Stress in Welded Plates—Clay P. Bedford, Berkeley, Calif., assignor to the Kaiser Co., Oakland, Calif., a corporation of Nevada

Bedford's apparatus includes a pair of hoods secured to a frame so as to provide an open space therebetween. Fluid discharge means are provided within the open space to deliver a cooling fluid to the weld zone and plates associated with the apparatus and to a tension zone immediately adjacent to the weld and lying on both sides thereof. Each hood has a plurality of longitudinally aligned burners supported therein to direct the greatest heat under the hood to the plates directly adjacent the lines of demarcation between the tension and compression zones in the welded plates. The heat is so applied that it is gradually reduced as the distance from these lines increases.

SECTION ACTIVITIES

Atlanta

The Atlanta, Ga., Section had a fairly successful meeting at the Atlanta Athletic Club on September 16th. A bar was set up from 6:30 until 7:30 and a dinner was served at that time. Robert S. Lynch, President, Atlantic Steel Co., Atlanta, gave an excellent talk.

Bridgeport

Walter Palmer, Eastern District Manager of Alloy Rods, Inc., was the speaker at the September 23rd meeting held at the Candlelite, Bridgeport, Conn. Mr. Palmer's subject, "The Use of Alloys in Welding," held the interest of the group continuously and had an excellent range from technical to actual shop work.

Chattanooga

The Chattanooga Section held its monthly dinner meeting on October 1st at the Chattanooga Golf and Country Club following the usual informal get-together.

J. B. Fuller, member of the National Board of Boiler Inspectors and Resident Inspector for the Chattanooga area, delivered a very informative and interesting lecture on "The History and Present Application of the A.S.M.E. Boiler Code." He told of the necessity for such a code and how it started. He told of his personal experiences with boilers over the past sixteen years. The necessity for one uniform code for all states was a point stressed by Mr. Fuller. J. R. Kruse, Chief Engineer of Combustion Engineering Co., during the discussion that followed, told of the plans now in progress by the A.B.M.A. to unify the A.S.M.E. Boiler Code.

Following the technical meeting, a talk "Chattanooga, A Place to Live," which was accompanied by Kodachrome slides was given by George Campbell. He compared trees, flowers, landscapes, waterfalls, industries, waterways and architecture of Chattanooga to famous places all over the world. Mr. Campbell has taken all his own pictures during his travels and gave a very interesting talk.

Tentative program for the remainder of the season is as follows: November 18th, "Resistance Welding," R. T. Gillette; December 17th or 18th, Xmas Party; January 20th, "Metallurgy for the Welder," A. L. Schaeffler; February 17th, "Maintenance Welding," Charles Keyser; March 17th, "Arc Welding Copper and Copper Alloys," F. E. Garriott and April 16th, Annual Meeting and Party.

Colorado

September 13th meeting of the Colorado Section was held at the Silver Wing Inn, Denver. Howard N. Simms, Metallurgist, Black, Sivalls & Bryson, Inc., and Director at Large of the A.W.S., spoke on the "Application of Welding Processes." Mr. Simms made a very interesting talk. Announcement was made of the proposed welding clinic and school to be conducted by the Section during the month of November.

Columbus

C. H. Jennings, Engineering Manager, Welding Division of Westinghouse Electric Corp., Buffalo, N. Y., was the guest speaker at the October 8th meeting held at the Fort Hayes Hotel. Mr. Jennings covered a subject which all welding engineers are constantly trying to overcome, "Distortion Problems in Welding."

The November meeting will be the Annual CTC Meeting and will be held at the Fort Hayes Hotel.

Mr. Jackson of Caterpillar will speak at the December meeting at the Fort Hayes Hotel.

Joint meeting will be held in January with the A.S.M. at the Fort Hayes Hotel with Mr. Aborn of U. S. Steel as the speaker.

The following are the officers of the Columbus Section: *Chairman*, R. R. Grant, Jaeger Machine Co.; *Vice-Chairman*, J. J. Schlass, Williams & Co.; *Secretary-Treasurer*, G. S. Herren, Seagrave Corp.

Dayton

The September 22nd meeting held in the Engineers Club was in the nature of a Quiz Show, with the audience asking the questions. Judge and Quiz Master was Frank M. Bernard, Welding Specialist, Westinghouse, Pittsburgh, Pa. Experts were W. H. Kaufman, Williams & Co., Pittsburgh; Al Mealy, Airco, Dayton; Glyn Williams, and Henry Bryan, Hobart, Troy. Prizes were given for the best questions. An added attraction was the showing of a movie, "Designing Machinery for Arc-Welded Construction," sponsored by Lincoln Electric Co., Cleveland.

Detroit

The 1948–49 Season got off in high speed on September 10th when the Section was entertained with a plant visit through the courtesy of the Ford Motor Car Co. at their River Rouge Plant.

Three hundred and one assembled at 7:30 P.M. in the auditorium of the Rotunda Building. The Section was welcomed by John Randall who gave a brief outline in well-chosen words on the welding processes which they would see in the carefully selected trip which would follow. The extent to which automatic welding is used was illustrated by the statement that of the 486 in. of welding in the frame they would see 416 in. done by the automatic submerged arc process.

Preceding the trip, movies entitled "Science at the Rouge," depicting how science and production go hand in hand, and "The Ford in Your Future," showing the various models of the 1949 car, were shown.

Si Fisher, and his staff, of the Guest Relations Dept., then took charge in his usual efficient and hospitable manner and the crowd was loaded in buses at the door which took them first to the Cold Heading Dept. and thence to the Press Shop. On the way, guides in each bus made general remarks about the plant and current production figures.

The trip was arranged by R. H. Barlow, Welding Engineering Dept., to show us how welding plays its part in the manufacture of over 5000 Fords each day. Practically every type of welding known to the art and science of welding was demonstrated.

Attesting to the interest displayed, the trip, originally planned for one and one-half hours, starting at 8:00 P.M. wound up with the last bus load arriving back at the Rotunda at 11:00 P.M. The discussion period originally scheduled for the close of the meeting had to be called off.

Included among those attending were 35 from the Saginaw Valley who chartered a special bus for the occasion.

Hartford

Dinner meeting of the Hartford Section was held on Thursday, September 16th, at The Whitlock Mfg. Co. Cafeteria, Elmwood, Conn. The subject "Magnesium Welding" was presented by R. A. Lautier, Stress Engineer, Design and Stress, and J. R. Dube, Shop Practice and Methods, Foreman, both of the Warren McArthur Corp.

The November meeting will be held on the 18th. A representative of The Linde Air Products Co., will discuss "Inert Gas Shielded Arc Welding." A demonstration of d.-c. and a.-c. current will also take place.

Lehigh Valley

The Lehigh Valley Section was highly honored to have as their guest Comfort A. Adams, the founder and first president of the American Welding Society, at the first meeting of the 1948–49 Season, held on Monday, October 4th, at the Hotel Bethlehem, Bethlehem, Pa. Mr. C. L. Kreidler, Chairman, presided at the meeting.

Dr. Adams related some of his experiences while training thousands of young men. He told of the educational system needed to train competent young men to approach present-day problems in a more practical manner.

"Welding Research at Lehigh University" was the topic discussed by Bruce G. Johnston, Director of Fritz Engineering Laboratory of Lehigh University, at the technical session which followed the dinner meeting. Dr. Johnston told of the progress being made in the current research projects undertaken by Lehigh.

He told of the proper approach to research projects, which he outlined. The discussion was illustrated with slides.

The Section was pleased to have J. G. Magrath, Executive Secretary of the AMERICAN WELDING SOCIETY, attend the meeting.

Long Beach

The first meeting of the fall season of the Long Beach Section was held at Miller's Restaurant, on Friday, September 17th.

The speaker was Stuart V. Jewell, of the H. K. Ferguson Co., who talked on how to obtain quality economically. His talk was very well received, as well as a film taken by himself while working at Oak Ridge, Tenn., for the Kelex Corp.

After his talk the meeting was open to questions regarding welding of alloys, and a lot of valuable information was obtained by the group.

Twenty-five members and guests were present.

Los Angeles

The first monthly dinner meeting of the Fall Season was held on Thursday, September 16th, at Scully's Restaurant. One hundred and forty-five members and guests were present.

Section Chairman, E. O. Williams, Vice-President of The Victor Equipment Co., opened the meeting by describing the administrative and executive personnel of the SOCIETY and their function in the National and local organizations.

Vice-Chairman Charles Haynes, of C. F. Braun and Co., was presented and presided over the remainder of the meeting.

Coffee talk was prepared by Frank Harkens, Welding Engineer of Solar Aircraft, San Diego. He was unable to attend so the paper was presented by J. W. Welty, Metallurgist of Solar Aircraft. The subject matter of his talk, "Resistance Welding of High Temperature Alloys" was commendably presented. Discussed concisely and clearly were types, compositions, uses and fabrication methods of high-temperature alloys. Particular attention was directed to the most desirable operating characteristics of resistance and flash-welding machinery. Maintenance, training of operators, cost control and inspection were also described in their relation to economical operation.

Dr. William G. Theisinger, Manager of Technical Plate Sales, Lukens Steel Co., presented, in his inimitable style, the principal talk of the evening, illustrated by slides and movies. Discussed were economy and flexibility of design by use of clad steels and suitable large plate sizes. His vivid presentation enhanced a wealth of material describing the manufacture, recommended welding procedures and fabrication applications of clad steel plate. Active interest in the subject was displayed by subsequent question and answer session.

Louisville

Frank E. Kessler, Field Engineer of the Welding Equipment and Supply Co., Detroit, addressed the Louisville Section at the September meeting held on the 28th in the Preston Kunz Restaurant. He spoke on the subject "Tool and Die Welding."

In his talk Mr. Kessler explained that there are a large number of die steels on the market, but that they all fall into four classes; namely, oil hardening, air hardening, water hardening and hot working. Welding rods and procedures have been developed for successfully welding each of the four classes of die steel. Detailed descriptions were made of several jobs where damaged dies were perfectly repaired by using the proper heat procedure and suitable rods. The talk was illustrated with talking slide films and a discussion period followed.

Preceding the technical speaker, a short business meeting was held and at the end of the meeting a Dutch Lunch was served.

The following officers have been elected for the fiscal year: *Chairman*, Mason S. Noyes; *Vice-Chairman* Murray Davis; *Secretary* Arthur B. Doudna and *Treasurer* Carl L. Jensen.

Michiana

The Michiana Section was favored with a talk by J. R. Stitt, Welding and Research Engineer for the R. C. Mahon Co., Detroit, and Chairman of the Detroit Section of the A.W.S., on the subject of "Why, When and How to Stress Relieve Steel Weldments." The talk was the result of an extensive series of experiments to measure the locked-up stresses in a cross-shaped weldment containing four fillet welds. After the method of measuring stress was determined, various heat treatments were applied and the stresses remaining compared to unheated specimens. The results, shown in graph form on slides, were very striking. A series of photographs showing a method of straightening large steel forms was also shown.

Preceding the talk, two short movies from the General Electric Co. library were shown.

Milwaukee

Regular monthly dinner meeting of the Milwaukee Section was held on Friday, September 24th, at the Ambassador Hotel.

After-dinner program consisted of a talk by Major Henry F. Gerecke, Chaplain, U.S. Disciplinary Barracks on his observations as Chaplain to the high Nazis at Nuremberg.

Main speaker of the evening was G. O. Hoglund, Welding Section Head of the Jobbing Division, The Aluminum Company of America, who spoke on "Welding Aluminum Alloys." His talk covered some of the metallurgical factors important to the welding of aluminum, as well as the fundamentals and practical applications of the various processes used for welding this metal. Mr. Hoglund also showed a short film on "Welding and Brazing Aluminum."

New Jersey

"Application of Welding to Aircraft Turbine Power Plants" was the subject of an address before the New Jersey Section on the evening of September 21st. The speaker was Herman Hanink, Assistant Chief of the Materials Laboratory of the Wright Aeronautical Corp., Wood Ridge, N. J.

Mr. Hanink first outlined the features of the "Turbo Jet," "Turbo Propeller," and "Ram Jet" engines and indicated the types of service for which each was adapted. The welding problems were then outlined and were shown to be interesting, particularly in view of the extreme temperatures and severe stresses involved. When it is realized that the turbine rotor operates at a bright red heat while rotating at many thousands of revolutions per minute, the magnitude of the engineering problems can be appreciated.

J. G. Magrath, Executive Secretary of the A.W.S., also spoke regarding the coming membership drive, and participation by top company management. All members were requested to participate in this drive.

The annual picnic of the New Jersey Section was a great success. Approximately 150 persons participated in this event, which was held on September 25th at Farcher's Grove, Union, N. J.

About 45 valuable prizes, ranging from fountain pens to radio sets, were awarded for the numerous contests and as door prizes.

E. W. Brass, of the Buffalo Tank Corp., was picnic chariman and was largely responsible for the pleasant time enjoyed by all.

H. H. Comstock, of the National Cylinder Gas Co., did an excellent job in rounding up the formidable array of prizes.

New York

The following is the program schedule for the remainder of the 1948–49 season. All meetings will be held at the Engineering Societies Bldg., except where otherwise noted.

Nov. 10, 1948, "Welding the Modern Diesel Locomotive," Harry S. Swan, Welding Engineer, American Locomotive Co., Schenectady, N. Y.

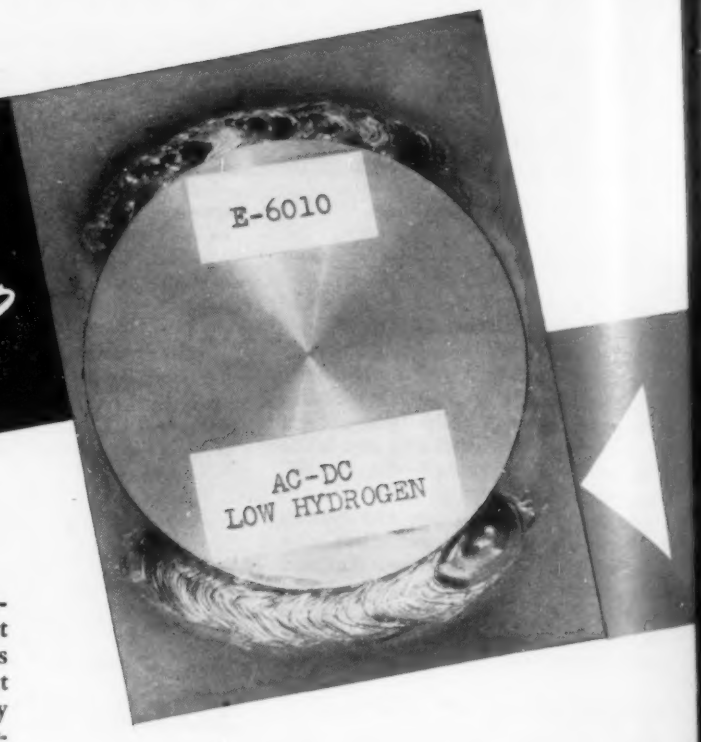
Dec. 8, 1948, "Symposium on Methods of Inspection of Welds." Moderator, A. Gobus, Sam Tour & Co., New York, N. Y.; W. Bunn, Welding Engineer, M. W. Kellogg Co., Jersey City, N. J.; H. Migal, Magnaflux Corp., New York, N. Y.; J. C. Smack, Sperry Products, Inc., Hoboken, N. J.

Jan. 20, 1949, Joint Meeting with the Society of Automotive Engineers at the Hotel Pennsylvania. "Welding Problems Encountered in the Automotive Industry," John Randall, Welding Engineer, Ford Motor Co. Dearborn, Mich.

Feb. 25, 1949, Joint Meeting with the Society of Naval Architects and Marine Engineers at the Columbia University Club. "Welding in Shipbuilding," Lyell Wilson, Research Director, American Bureau of Shipping, New York, N. Y.

Mar. 16, 1949, Joint Meeting with the American Society of Civil Engineers. Welded Bridges and Structures, LaMotte Grover, Air Reduction Sales Co., New York, N. Y.

Welding Hardenable or Sulphur-bearing Steels?



1. Fewer structural failures from underbead cracking—Ordinary electrodes deposit a large amount of hydrogen in weldments on hardenable steel. This produces underbead fissures *not* generally apparent in routine inspection, which in turn causes early structural failures in service. General Electric *low-hydrogen* rods have a special coating which materially reduces the amount of hydrogen deposited, thereby largely eliminating the basic cause for such failures.

2. Better mechanical properties—Laboratory comparisons between these low-hydrogen electrodes and class E6010 electrodes show the former to possess higher tensile and yield strength, better elongation, and *higher impact* at both room and sub-zero temperatures.

3. Welds can be successfully enameled without heat treatment—as has been actively demonstrated on both a laboratory and production basis.

4. Materially improved operating characteristics—G-E low-hydrogen electrodes are extremely flexible in application, with either a-c or reverse polarity d-c; spatter is minimized, deposition efficiency is high, penetration is adequate but not excessive. There is little or no tendency for surface holes to occur in metals of relatively high sulphur content—and in all cases the finished weld offers an excellent appearance. (Note lower bead in photo above.)

THESE ARE THE G-E "LOW-HY FAMILY"

W-32 is the "father" of the line, having been offered since 1945. A new, greatly improved version was recently introduced—and this performance-proved electrode is now listed at a new, attractive price.

W-60, W-61, W-62 are three brand new additions, with recommended applications as follows:

W-60—For welding hardenable steels where hazards of underbead cracking are to be eliminated.

W-61—For a wide variety of low-alloy, "high-tensile" steels.

W-62—For use on steel castings and for producing weld deposits having high impact properties at subzero temperatures.

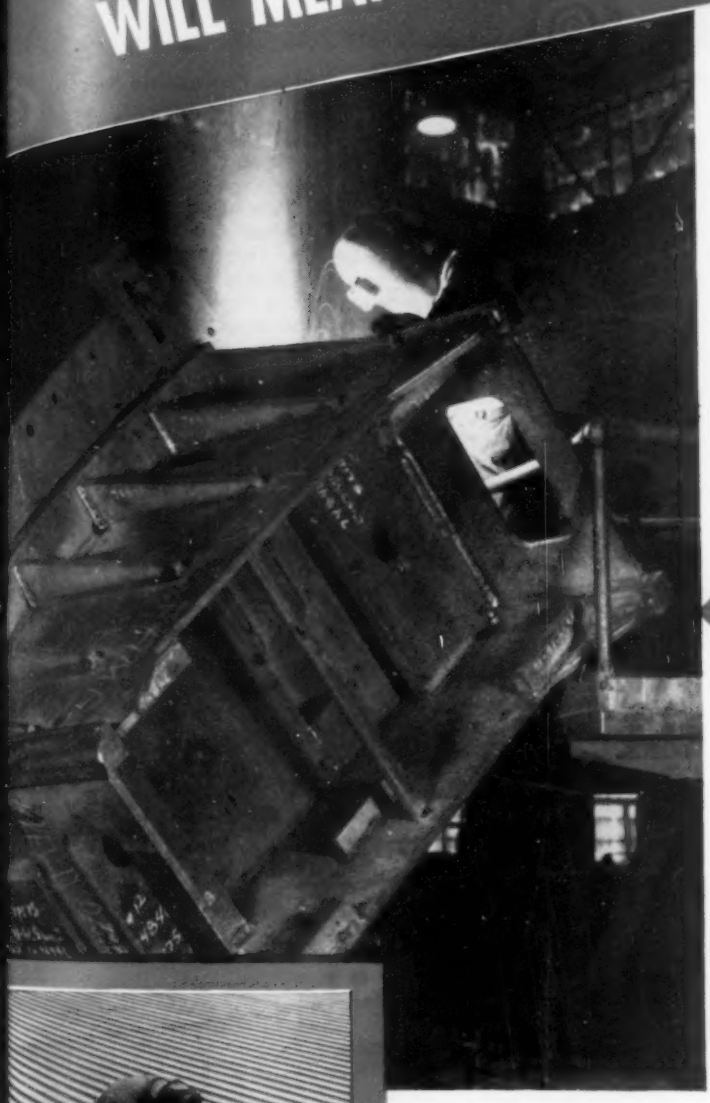
AND THESE OTHER G-E ELECTRODES CAN DO AS MUCH FOR OTHER WELDING JOBS

Mild-Steel and General-Purpose Electrodes—This group of 9 types is headed by W-28, a new general-purpose, all-position rod with an unusually stable arc that produces welds of superior appearance, at high speeds, with minimum convexity. Other electrodes in this group are available specifically for horizontal, vertical, or over-head welding, etc.

Stainless Steel Electrodes—27 types (16 for d-c, and 11 for a-c or d-c) make this one of the most complete stainless lines available. Each type is keyed to specific AISI code numbers for easy selection. Special, double-carton packaging protects the rod against moisture as well as providing extra protection against transit and storage damage.

Cast-Iron, Hard-Surfacing, & Phosphor-Bronze Electrodes—Herein are some of the more recent additions to the G-E electrode line; W-2075 for making machinable welds on cast-iron; W-94 for abrasion-resistant, hard-surfacing applications; and W-70 for phosphor-bronze welding. They are exemplary of G. E.'s welding laboratories' constant search for better electrodes, improved equipment, and more efficient welding processes.

HERE'S WHY G-E LOW-HYDROGEN ELECTRODES WILL MEAN MONEY IN YOUR POCKET



HERE'S WHAT USERS FIND WITH G-E "LOW-HY" ELECTRODES

Production had virtually stopped at a Pennsylvania machinery manufacturer's plant because cracks were developing in weld-fabricated steel parts. A rush shipment of W-32 from our Philadelphia distributor eliminated the cracking and had them back in production the same afternoon.

Arc welding in general and W-32 electrode in particular played an important part in fabricating this ram or slide for a 200-ton, straight-side crank press. Welded construction with W-32 was used extensively throughout the entire press.

A mid-western transformer manufacturer now swears by W-32 after finding that it completely eliminated a severe cracking and porosity problem in the fabrication of transformer tanks.

You can order these low-hydrogen electrodes from your G-E Arc-welding Distributor today. And ask him for your copy of the new pocket-sized electrode catalog, GES-3571. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

Copyright 1948, General Electric Company

"A-C or D-C . . . there's G-E Arc-welding Equipment for Every Application!"

ARC WELDERS • ELECTRODES • ACCESSORIES

GENERAL ELECTRIC

673-72

Apr. 13, 1949, The Battle of the Section. Stump the Expert Quiz.

May 1949, Annual Social Meeting. Date to be announced.

Northwestern Pennsylvania

The first dinner meeting of the season was held on Wednesday evening, September 29th, at the G. E. Community Center, Erie, Pa. Social hour from 6:30 to 7 P.M. was held in order to afford an opportunity to renew old acquaintances and make new ones. The dinner at 7:00 P.M. was one of Mrs. Moss' celebrated dinners. In place of the coffee talk, a color and sound picture, "Pheasants Galore," was shown through the courtesy of Winchester Arms Co. This picture shows the shooting of pheasants in South Dakota.

The evening was devoted to "Cutting of Stainless Steel by Flux Injection Method." Speaker was Ben Grimes, Supervisor Technical Sales, Buffalo District, Air Reduction Sales Co. His talk was supplemented by a color and sound picture, "No Keener Blade," and a second reel "Stainless Steel Cutting by Flux Injection Method."

Oklahoma City

The Oklahoma City Section held its first meeting of the season on Wednesday, September 8th, at Jack Barn's Club Room.

W. H. Greer, of the Southwestern Laboratories, Houston, Tex., presented a talk with slides on "Welded Building Construction," and his talk was received with considerable interest by a group of approximately forty members and guests. Mr. Greer's talk was virtually entirely on a nontechnical basis.

After the regular meeting, doughnuts and coffee were served to the entire group and this did much to create an excellent feeling of good fellowship and it also did much to get the group on a "better acquainted basis."

Pascagoula

The Pascagoula Section held its first meeting of the season at the Pascagoula Country Club, Wednesday, September 22nd. The dinner meeting was under the chairmanship of D. G. Peattie, Vice-Chairman of the Section. Mr. Peattie gave a coffee talk on the Section's proposed activities for this season. LaMotte Grover, Chairman of the Structural Steel Research Committee of the Welding Research Council and Chief Welding Engineer for Air Reduction Co. and Dr. Finn Jonassen, Technical Director of the Committee on Ships Steel of the National Research Council both spoke during the technical section.

Mr. Grover spoke on welded steel structures and welding procedures. He spoke briefly describing the test program of the box girders which had been designed for the purpose of throwing more light upon the cracking difficulties that were experienced by some of the shipyards during the war. All of the box girders constructed by Ingalls and tested under load he remarked, had shown remarkably good behavior as have the welded ships that have been constructed by Ingalls.

La Motte Grover addressing September 22nd meeting Pascagoula Section

Mr. Grover also discussed the rapid advancement of welded bridges and buildings constructed in the United States and Canada and in various European countries where many welded railway bridges have been built.

Dr. Finn Jonassen presented a brief outline of the various other research programs having a bearing upon the problems of the failures of welded ships. These other programs have been conducted under the auspices of the Ships Structure Committee, which is constituted of representatives from the United States Navy Bureau of Ships, the United States Coast Guard, the United States Maritime Commission, the Transportation Corps of the U. S. Army, and the American Bureau of Shipping.

LaMotte Grover and Dr. Finn Jonassen's visit to Pascagoula was occasioned by the starting of the residual stress measurements for a large experimental box girder which was being tested at the Ingalls Shipbuilding Corp. This was the sixth of a series of six of these girders that have been constructed at the Ingalls Shipyard for the Welding Research Council.

Philadelphia

On September 20th the Philadelphia Section held its regular meeting at the Engineers Club.

The speaker of the evening was H. W. Pierce, assistant to the president of New York Shipbuilding Corp. Mr. Pierce spoke on the topic "A Welding Engineer's Tour Through Japan." Mr. Pierce's experiences while serving as an observer for a government agency were interesting and entertaining both from a technical view as well as from the viewpoint of a traveler in a foreign country recently ravaged by war.

Discussion which resulted from questions asked by the members indicated a keen interest in the economic and technical status of a recently fallen enemy nation.

The meeting adjourned to refreshments after the discussion.

Portland

A joint dinner meeting with the American Society for Metals was held at the Congress Hotel. Sixty-six members and guests were present.

Chairman Joe Crumley called the meeting to order and introduced the program chairman, John Bristow, who after a short talk and some entertaining stories presented the speaker of the evening, Dr. William G. Theisinger.

Dr. Theisinger's subject was "The Manufacture, Fabrication and Application of Clad Steels." Slides and motion pictures were shown in order to bring out the high points of his lecture.

After Dr. Theisinger answered many questions, the meeting was adjourned by Chairman Joe Crumley.

San Francisco

At a dinner meeting held on September 20th at the Engineers Club, W. Popert and C. R. Owens reported on the Structural Committee. Report was well received.

Feature speaker of the evening was Dr. W. G. Theisinger, Manager of Sales Development, Lukens Steel Co., Coatesville, Pa. Dr. Theisinger's subject, "Manufacture, Fabrication and Application of Clad Steels," was very interesting. A film "Luken's Clad Steel" was shown in conjunction with the talk.

South Texas

September dinner meeting was held on the 10th at the Ben Milam Hotel, Houston. Dinner speaker was A. E. Wisler, Chairman of the South Texas Section, who spoke on the objectives of the Section for the coming season.

Speaker at the technical session was W. H. Greer, Assistant Manager, Southwestern Laboratories, Houston, who spoke on "Welded Building Construction." Slides illustrating methods of construction were shown. Houston has embarked on extensive multistoried building construction. This has aroused considerable interest in many parts of the country. Mr. Greer has been very active in design and inspection of this type of construction.

Syracuse

The host for the September 15th meeting, held at the Hotel Syracuse, was the Central Greyhound Lines of New York, Inc. In addition to defraying the expenses of this meeting, they furnished a print of the movie "Amazing America."

The subject of the technical session was "Machine Flame Cutting" by R. F.

Helmkamp, Air Reduction Co. In connection with the talk there was a picture, "No Keener Blade," which showed some of the latest developments in flame cutting.

Toledo

Officers of the Toledo Section for the fiscal year commencing June 1, 1948, are as follows: *Chairmen*, E. V. Newman; *1st Vice-Chairman*, S. W. Snell; *2nd Vice-Chairman*, W. H. Marion; *Secretary-Treasurer*, Edwin Nafzger; *Chairman, Membership Committee*, W. H. Marion and *Chairman, Program Committee*, Sam W. Snell.

Tulsa

Officers of the Tulsa Section are as follows: *Chairman*, Floyd Silvers; *Vice-Chairman*, James B. Davis; *Secretary*, H. K. Abernethy; *Treasurer*, Walter Gippelt and *Executive Committee Members*—W. W. Danuser, C. B. Gannaway, Jr., R. L. Looney, J. G. Neet, F. D. Davenport, F. O. Johnson, Parker Patterson, Emil Augustine, P. W. McKee and J. M. Krisman.

Washington

A display and demonstration of metallizing equipment in operation was shown on the afternoon of September 28th at the Southern Oxygen Co., Bladensburg, Md., from 2:00 to 5:00 P.M.

Dutch Treat Dinner at 6:30 P.M. was at O'Donnell's Restaurant.

Meeting at 8:00 P.M. was held in the Pepco Auditorium. The subject, "Metallizing," was presented by D. C. Boltz, Head of Government and Export Dept., Metallizing Engineering Co., Inc.

The second monthly meeting of the Washington Section was held on October 19th at the Westinghouse Electric Corp., Lansdowne Plant on U. S. Route No. 1, south of Baltimore. A dinner featuring 8-oz. steaks or chicken was arranged for 7:00 P.M. A movie and short talk took place after dinner. A guided inspection tour of the plant to observe the manufacture of radio frequency heating equipment was scheduled.

Program for remaining meetings of the season is as follows:

Nov. 30, 1948, Pepco Auditorium, 8:00 P.M., "Structural Welding," Van Rensselaer P. Saxe, Consulting Engineer.

Dec. 17, 1948, Pepco Auditorium, 8:00 P.M., "Welding Metallurgy," Dr. S. L. Hoyt, Battelle Memorial Institute. Joint meeting with American Society for Metals.

Jan. 25, 1949, Pepco Auditorium, 8:00 P.M., "Control of Weldment Quality," O. R. Carpenter, Engineer, Babcock & Wilcox Co.

Feb. 15, 1949, Pepco Auditorium, 8:00 P.M., "Arc Welding Electrodes," Dr. G. E. Claussen, Metallurgist, Reid Avery Co.

Mar. 29, 1949, Pepco Auditorium, 8:00 P.M., "Developments in Inert Gas Arc Welding." Speaker from the Air Reduction Co. to be announced.

Apr. 26, 1949, Twelfth Anniversary Dinner. Speaker, G. N. Sieger, President, SMS Corp., President, A.W.S.

Western Michigan

Officers for the Western Michigan Section are as follows: *Chairman*, John Borman; *1st Vice-Chairman*, James Manley; *2nd Vice-Chairman*, Robert Kemp; *Secretary-Treasurer*, I. R. Bartter; *Chairman, Membership Committee*, Everett Lane; *Chairman, Recording Committee*, Dudley Layman; *Chairman, Program Committee*, James Manley and *Chairman, Publicity Committee*, L. Harriss.

Western New York

Over 100 members and guests were present at the Hotel Touraine, Buffalo, N. Y., for the September 23rd meeting, held to celebrate the 25th Anniversary of the Section, and to honor its national officers. The following officers were present: H. O. Hill, President, O. B. J. Fraser, Vice-President, G. N. Sieger, President-Elect and J. G. Magrath, Executive Secretary. Mr. Hill discussed the changes which have taken place in the national organization during his term of office, and brought the local members up to date on the many activities of the Society. Mr. Sieger discussed the future of welding and the Society, and was followed by Mr. Fraser who discussed the financial status and did a fine job of explaining the recent rise in dues. Mr. Magrath elaborated further on the activities of the Society and discussed at length the manner in which the local Section should and does function in conjunction with the National Headquarters. The coming membership drive was also fully discussed.

After a brief review of the local history of the Section by G. M. Trefts, District Vice-President, awards of past-chairmen pins were made to all living past chairmen.

Following the meeting national and local officers met with members from the Olean, N. Y., and Erie, Pa., areas, and plans were formulated to create a subsection of the Western New York Section in Olean to provide closer association of members from outlying sections with the Society during the winter months when travel is difficult. The relative areas of influence of the Erie and Western New York Sections were decided upon and both Sections will aid in the operation of programs for members in outlying areas. The many members and guests who attended the meeting left with a greater appreciation of what the Society means to them, greatly enthused over its progress, and ready to take an active part in increasing the membership.

The following is the program of future meetings. See monthly notice for exact confirmation.

Nov. 11, 1948, Joint Meeting of the American Society of Mechanical Engineers and the Society of Automotive Engineers. Subject: Welded Design.

Dec. 16, 1948, Joint Meeting, American Society of Safety Engineers. Subject: Safe Practices in Welding.

Jan. 5, 1949, Joint Meeting, Niagara Frontier Society, Industrial Engineers. Subject: Incentive and the Production of Welded Assemblies. Speaker: J. F. Lincoln.

Feb. 18, 1949, Joint Meeting, Society of Quality Control Engineers. Subject: The Control of Quality in Welding.

Mar. 24, 1949, Joint Meeting, American Society of Civil Engineers and American Institute of Architects. Subject: Structural Design for Welded Fabrication.

Apr. 21, 1949, Joint Meeting, American Foundrymen's Association. Subject: Welding and Repair of Castings.

May 19, 1949, Joint Meeting, American Institute of Electrical Engineers. Subject: Electrical Energy in Welding. Speaker: Mario Sciaky.

June 16, 1949, Annual Party and Installation of Officers.

Wichita

The first meeting of the season was held on September 13th at the Broadview Hotel. Speaker was Howard N. Simms, Director of Quality Control for Black, Sivalls & Bryson, Inc., of Oklahoma City, Okla., and Kansas City, Mo. The subject was "Application of Welding Processes."

Mr. Simms developed his subject in a highly interesting and informative manner, showing a fine series of slides which he has so ably developed for audience comprehension. The presentation was so thoroughly thought-provoking that a lively question and answer period was enjoyed by all present. Even though the crowd was not large, the meeting was a definite success.

York-Central Pa.

Dinner meeting was held on October 5th. Dinner was at the Yorktowne Hotel and the meeting in the Engineering Society Bldg., York. H. T. Herbst, Development Engineer, The Linde Air Products Co., presented an interesting discussion on "Inert Gas Shielded Arc Welding," which was illustrated with slides. A movie of the Middleweight Title Bout was also shown.

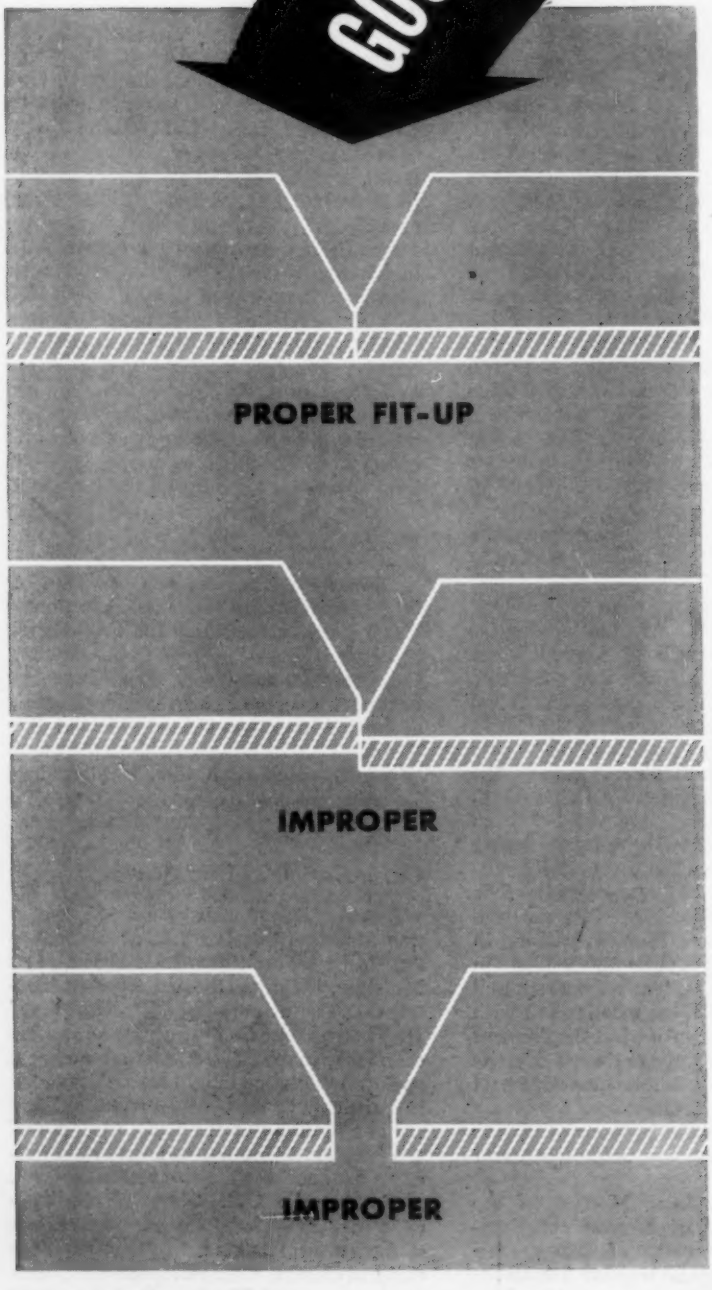
Canadian Welding Society

Meeting Day for the Toronto Chapter was Monday, October 4th, at Malloneys Art Gallery, Toronto. R. G. Alison, Sales Manager, Welding Division, Lincoln Electric Co., Toronto, spoke on "A New Day." H. Thomasson, Welding Engineer, Canadian Westinghouse Co. Ltd., Hamilton, spoke on "Polarized Light Reveals Stresses in Fabricated Joints—A Demonstration."

First Meeting of the 1948–49 Series of the Hamilton Chapter was held on Tuesday, October 5th, at McMaster university, Hamilton. Prof. E. George Webb, Associate in Farm Machinery of Department of Agricultural Engineering, Ontario Agricultural College, Guelph., spoke on "Farm Tillage Tests of Welded Hard Surfacing Alloys."

The first meeting of the 1948–49 series of the Kitchener-Waterloo Chapter was held on Wednesday, October 6th, at K-W Y.M.C.A. Auditorium. Prof. E. George Webb, Associate in Farm Machinery of Department of Agricultural Engineering, Ontario Agricultural College, Guelph., spoke on "Farm Tillage Tests of Welded Hard Surfacing Alloys."

GOOD FIT-UP IS Necessary



In welding clad steels, accurate alignment and fit-up of edges to be welded is an important step following preparation of plate edges. Care in this operation simplifies the welding work. It is then easier to make a joint having high structural strength and preserving the integrity of the corrosion-resistant clad surface.

After establishing the alignment of the clad edges, tack-weld on the steel side to hold it there. Use any good grade of carbon steel electrodes. Then lay down the root bead on the steel side, taking care not to penetrate the cladding.

Complete the weld on the steel side and then chip it back from the clad side until sound weld metal is uncovered. Finally, fill this in with rod matching the cladding. You will have an unbroken corrosion-resistant surface, providing the protection for which the Lukens Clad Steel was selected.

Clad steels are readily welded if the joint is properly designed and the correct procedure followed. Lukens new 100-page booklet, "Fabrication of Lukens Clad Steels", contains information that should be helpful to you. For a copy of this Bulletin 399, write Lukens Steel Company, 407 Lukens Building, Coatesville, Pennsylvania.

LUKENS

Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS

SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

• • SPEED SCRAP TO THE MILLS TO MAKE MORE STEEL • •